ENGINEERING AND MINING JOURNAL

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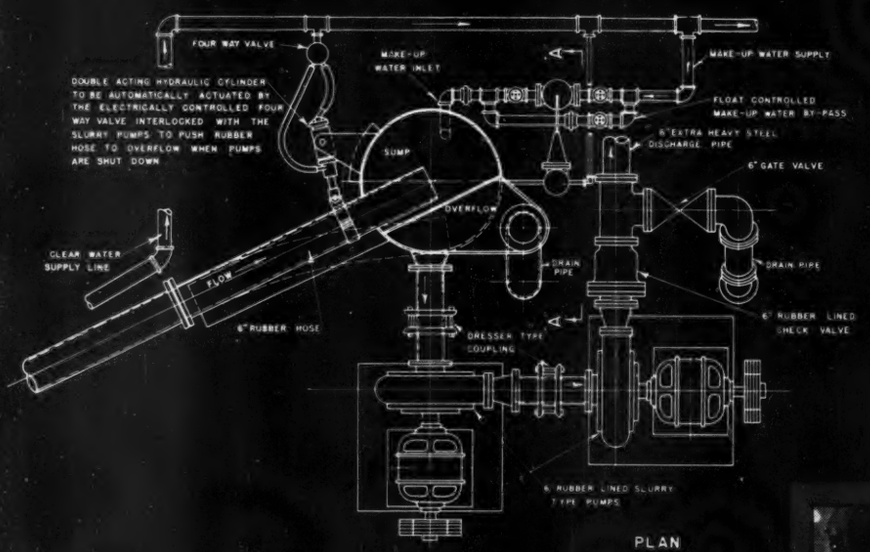
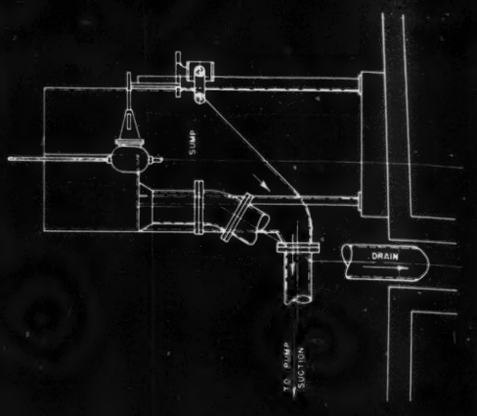
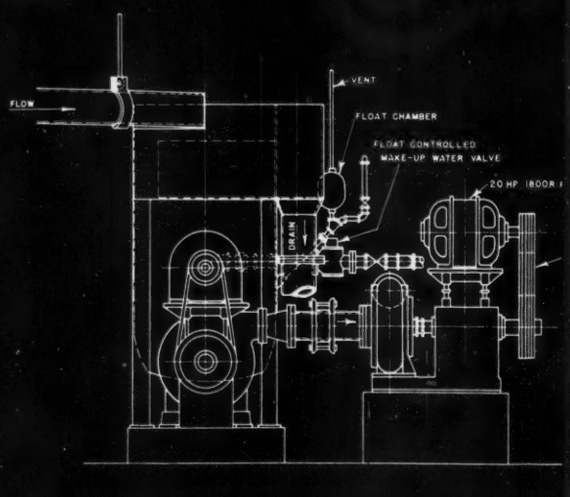
Shuttle car in Carlsbad potash mine transfers its load to train in main haulageway

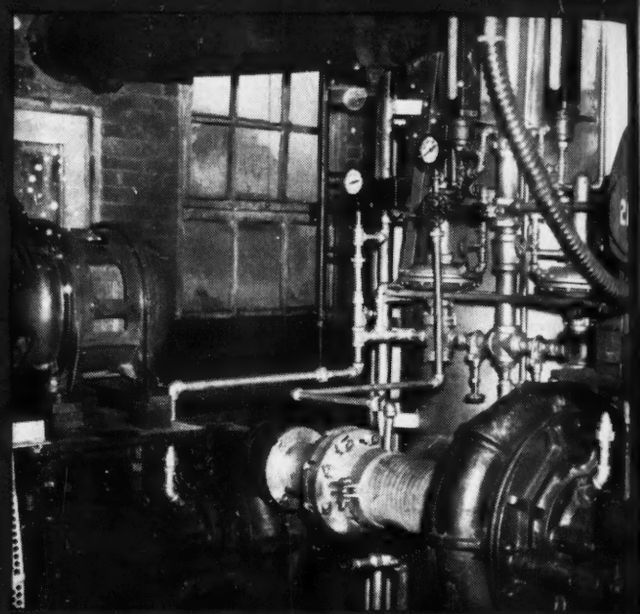
Selective Flotation at Balmat Mill— Page 56


FOUR WAY VALVE
MAKE-UP WATER INLET
MAKE-UP WATER SUPPLY
DOUBLE ACTING HYDRAULIC CYLINDER TO BE AUTOMATICALLY ACTUATED BY THE ELECTRICALLY CONTROLLED FOUR WAY VALVE INTERLOCKED WITH THE SLURRY PUMPS TO PUSH RUBBER HOSE TO OVERFLOW WHEN PUMPS ARE SHUT DOWN
FLOAT CONTROLLED MAKE-UP WATER BY-PASS
6" EXTRA HEAVY STEEL DISCHARGE PIPE
SUMP
6" GATE VALVE
OVERFLOW
CLEAR WATER SUPPLY LINE
FLOW
DRAIN PIPE
DRAIN PIPE
6" RUBBER HOSE
DRESSER TYPE COUPLING
6" RUBBER LINED CHECK VALVE
6" RUBBER LINED SLURRY TYPE PUMPS

PLAN







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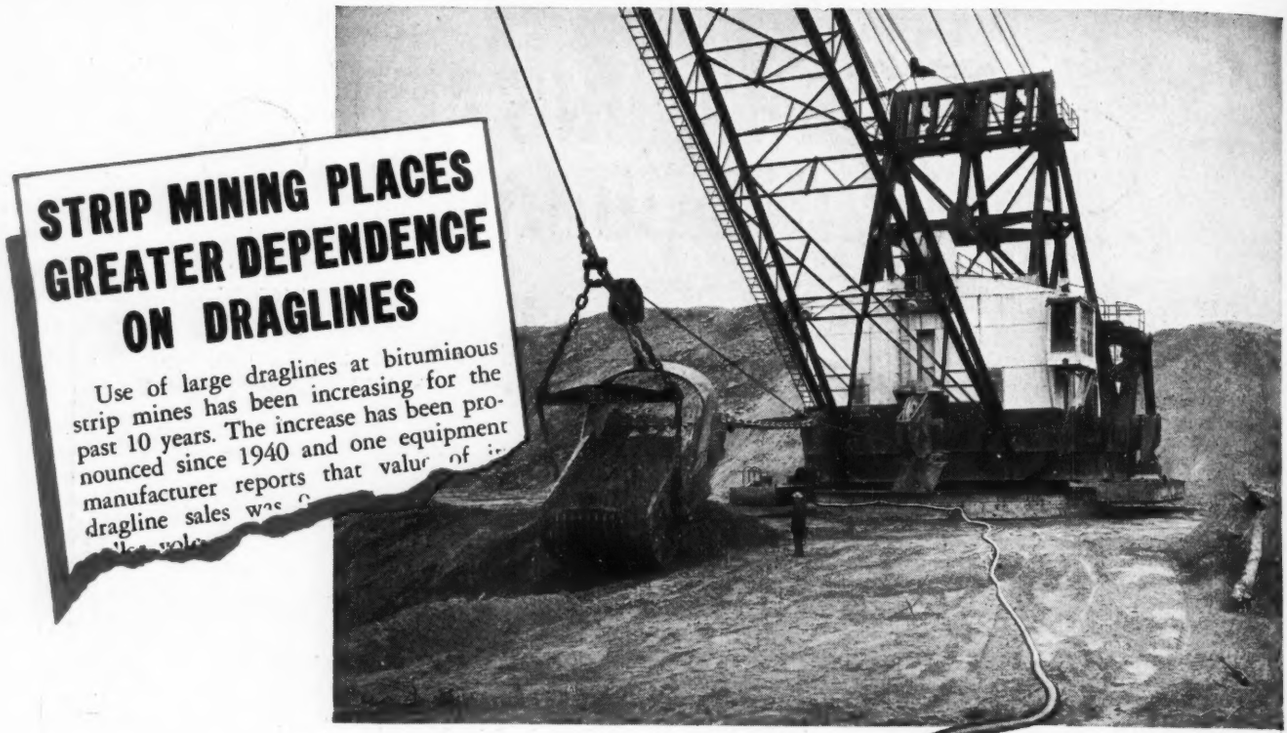
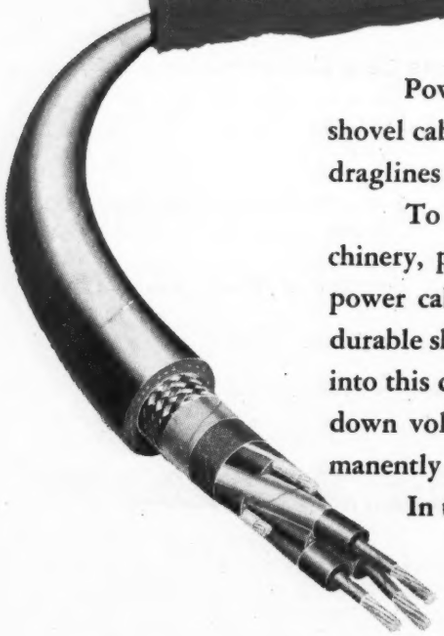


STRIP MINING PLACES GREATER DEPENDENCE ON DRAGLINES

Use of large draglines at bituminous strip mines has been increasing for the past 10 years. The increase has been pronounced since 1940 and one equipment manufacturer reports that value of [illegible] dragline sales was [illegible]

. . . and OKONITE CABLES keep them working night and day



Powering this 25-yard walking dragline is a 5 Kv Okoprene-protected shovel cable. It is typical of cables engineered by Okonite for shovels, dredges, draglines and other portable power leads operating up to 38,000 volts.

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ENGINEERING AND MINING JOURNAL

NOVEMBER, 1946

Sales Urges Conservation and Enterprise

DISCUSSING "Ore Reserves and Future Exploration" at the recent American Mining Congress meeting in Denver, Reno Sales, chief geologist for Anaconda, expressed such well-founded views that we are pleased to quote the following excerpts and recommend study of the full statement:

"If we do not find more new orebodies of copper, lead, and zinc in the next forty years than were found in the last forty, the 'have-nots' will have won the argument. But first, we must not waste or throw away important reserves in process of development.

"In my opinion the undiscovered copper, lead, and zinc possibilities in and adjacent to our operating mines are much more important to us as a reserve, or from any other viewpoint, than the so-called low-grade deposits now idle and awaiting the development of new technologies. . . .

"Any one familiar with our mountainous Western states can recall to mind large tracts in which there are no mining activities. It is easy to say that these vast unsettled regions contain hidden mineral possibilities awaiting discovery through improved prospecting technique. But let us not forget that included in these areas are mountains, hills, and valleys, which can be definitely eliminated as possible sources of mineral discoveries. . . .

"But there is a brighter side to this picture. There are many mountain ranges and hills disclosing the presence of mineralization, fissuring, contact zones, rock alteration, granite or other favorable igneous complexes, from whose sides detritus-covered slopes, or pediments, extend outward for long distances toward drainage valleys. The detrital covering will present a serious handicap just as in the past, but the field will be considerably enlarged if and when geophysical or other prospecting equipment reach a higher degree of usefulness. . . .

"It is my opinion that the 'must' course of action for our nation is one that will insure continuance of operations in our important mines and mining districts until all ore obtainable within a reasonable metal price limit has been exhausted. The marginal, possible, and prospective ores of these districts far transcend in importance at the moment the so-called 'vast unscratched resources' awaiting discovery. We should not sacrifice our best prospects on the theory of finding orebodies which may not exist. The lesson of forty years of prospecting has taught us just that. At the same time everything possible should be done to aid and encourage the prospector and the small miner, because it is to them we must look for the original discoveries from which reserves are ultimately developed. There has been no demonstration as yet that our country is in the 'have-not' class.

"Finally, let no user of copper, lead, or zinc, whether he be manufacturer or ultimate consumer, be lulled into a state of complacency by those who advise that if and when our copper, lead, and zinc reserves are exhausted, we will import our needs from foreign countries. What foreign country, may I ask, and at what price? Most countries have been prospected except in remote or inaccessible regions. No one at this moment has good reason to expect that new important deposits in foreign lands will be found more easily than in our own. But assuming a build-up of foreign reserves, and that the time may come in the not distant future when our status will be that of a truly 'have-not' nation, import prices may be such as to make our present-day metal prices seem ridiculously low.

"This nation must preserve its mining industry as long as possible and maintain it at high standards of efficiency, which means the preservation also of our technical skill. We must protect also the interest and enthusiasm of the individual for prospecting, mining, and 'striking it rich,' built up since the day of gold discovery in California, and not allow it to die with this generation or the next. If we fail, those who will suffer most, eventually, are the great manufacturing industries using copper, lead, and zinc; and along with them that every-day American citizen know as the 'ultimate consumer,' who finds one or more of these metals in nearly every article of commerce designed to raise his standard of living."

St. Joe's Balmat Mill—Problem in Four Dimensions

JAMES CASALE, Assistant Mill Superintendent, St. Joseph Lead Co., Balmat, N. Y.

The weather, perverse mineral behavior, a delicate three-way flotation separation, and ordinary mechanical difficulties all are blended to make up the problem that is solved continuously by the company's staff at Balmat. In this unusually complete and stimulating article, Mr. Casale tells how, and with what, the job is done.

MILLING FACILITIES of the Edwards Division of the St. Joseph Lead Co. consist of two units, the Edwards mill, at Edwards, in St. Lawrence County, 14 miles east of Gouverneur, N. Y., where 350 to 400 tons of zinc ore is concentrated per day, and the Balmat plant mill, 10 miles southeast of Gouverneur, where 1,225 tons of lead-zinc-pyrite ore is milled per day. Zinc concentrates from both mills are shipped to the Josephtown electrothermic zinc smelter of the St. Joseph company at Josephtown, Pa. Balmat lead concentrates are sent to the company's lead smelter at Herculaneum, Mo., and Balmat pyrite concentrates to the General Chemical Co. plant at North Claymont, Del. The Edwards operation started in 1915; the Balmat mill in 1930. The company entered the northern New York mining field in 1926.

Flowsheets and accompanying legends will suffice for the detailed description of the mechanical plant in the Balmat mill. The chief purposes of this article are to discuss the metallurgical problem at Balmat and to describe some of the more interesting mechanical details.

Crusher Needs Help

All crushing is done in two eight-hour shifts per day. Whenever one of the crushing shifts coincides with the power peak-load period, crushing and ore hoisting are done in separate alternate periods of 1 to 2 hours to avoid an excessive power peak. On the whole, the crushing plant operates as painlessly and efficiently as the present obsolete, well-worn equipment will permit. Lost time is caused chiefly by plugging of chutes and rolls, and rarely by plugging up at the jaw crusher. On occasions when unusually wet ore is hoisted from the mine, the capacity of the crushing plant is seriously decreased. The ore is worried through the two gyratories, which in any case are the bottleneck of the crushing plant. Efficiency of the rolls is maintained by welding them up daily. Mantles worn out in gyratory service are built up by welding and returned for further service.

Fine-Ore Bin Too Small

A rather weak spot in the crushing plant is fine-ore bin capacity, which is too small (total 850 tons' live capacity), in view of daily tonnage milled (1,225) and the 16 hours' available crushing time. On occasions, the mill has been shut down temporarily for lack of ore, due either to mechanical trouble in the crushing plant or to failure of the mine to deliver ore on schedule. Two of the three fine-ore bins have conical bottoms. Syntron vibrators have been found to be valuable aids in maintaining an even flow of ore from these conical tanks and in emptying them when ore supply becomes low.

As soon as materials and labor are available, a new crushing plant of 125-plus tons' hourly capacity will be built at Balmat, including fine-ore bin capacity that is fully adequate for the size of the operation. It is also planned to deliver a finer feed to the grinding section from this new crushing plant.

The head sample of the feed to the flotation plant is taken off the conveyor belt immediately preceding the rod mill. Sampling of the crude ore is done with an automatic Galigher sampler set to take a clean sweeping cut of ore every 12 minutes over the conveyor belt. Lack of headroom prevented the installation of the usual automatic device designed to cut a falling stream of ore. The cutter, H-shaped and lined with old conveyor belting, makes a clean sweep across the belt in one direction and in the opposite direction on the next cut. The same type of sampler has been installed to sample final lead, zinc, and pyrite concentrates from the conveyor belts moving these products to the loading shed. It has been found equally efficient on inclined and horizontal conveyor belts. All pulp samples in the flotation mill are taken by Galigher samplers of the conventional type, cutting a falling stream of pulp. Monthly metallurgical balance of metals in the heads against metals in all final products is well within 1 percent margin of accuracy.

Lead Floated Quickly

The Balmat grinding circuit is characterized by the insertion of the lead flotation circuit in closed circuit with the grinding-classifier units, and by the adoption of one simple grinding circuit to handle the total tonnage, as compared with several grinding circuits in parallel in many mills treating a comparable daily tonnage.

The essential problem of lead flotation at Balmat is the separation of a small percentage of lead (0.67 percent lead in January 1946) from an ore containing a much larger percentage of zinc (9.90 percent

SYLVIA LAKE, NEAR THE BALMAT MILL, supplies 35-deg. F. water for winter-time milling, which makes necessary special techniques to produce results as good as those of summer. Changes in reagents and close attention to operating details are the means by which this seasonal variation in the milling problem is solved. The plant has a capacity of 1,225 tons of ore daily.

zinc in January 1946) and of pyrite (11.18 percent iron as pyrite in January 1946) in a flowsheet designed primarily to do an optimum job on the zinc content of the ore. The reason for the insertion of the lead flotation in closed circuit with the grinding units is simply to remove as much galena as possible before this brittle mineral can be differentially overground and thus slimed and lost in the subsequent lead flotation.

The lead content of Balmat ore, always low, gradually dropped from 1.68 percent in 1930 to 0.61 percent in 1945, but nevertheless recovery of lead dropped only from 67 percent in 1930 to 62 percent in 1945. Lead tailing was lowered from 0.30 percent lead before the insertion of lead flotation in closed circuit with the grinding circuit to 0.22 percent after this change was made. Furthermore, the lead content of Balmat zinc concentrates was reduced from 1 percent before the change to 0.40 percent after the change, thereby improving the efficiency of smelting these concentrates.

The present simple grinding circuit, which gives a product 8 to 12 percent plus-48 mesh and 75 percent minus-65 mesh, a relatively coarse grind, enables a satisfactory recovery of zinc and pyrite to be made. There is room for improvement through a somewhat finer grind giving a product 2 to 5 percent plus-48 mesh. This improvement should be realized when the new crushing plant delivers a finer product to the grinding section.

Handling Rod Mill

At the end of each operating week, as many rods as possible 1 in. in diameter or less are pulled out of the rod mill and discarded, and a batch (20 to 30) of new 2½-in. rods is added. High-carbon steel rods could be used and these rods allowed to wear out fully in service, but the decrease in grinding efficiency and capacity of a rod mill with a large proportion of undersize rods is the deterring factor.

Rod steel consumption is 1.08 lb. and ball steel consumption is 0.65 lb. per ton of ore. Triple-forged steel balls, 2½ in. in diameter, are used in the ball mill. Ball and rod mill liners are of manganese steel with a layer of ⅜-in. oaken boards between liners and shell. All liners in the rod mill are zincked in, but only the end liners in the ball mill. The ⅜-in. boards are spaced 1½ in. apart to allow molten zinc to flow for ¾ in. under each side of the liners and thus become anchored in upon solidification.

Oiling of the rod and ball mills, as in all major machinery in the Balmat mill, is done by means of automatic oil pumps of the Manzell type. This method has resulted in more regular and more certain lubrication, less dependence on (but certainly not elimination of) the human factor, and, withal, considerable economy in lubricating oil. These automatic oilers are also used to apply the very viscous, heavy gear lubricant used on the ring gears of the rod mill, ball mill, classifier, and dryers. To make possible the pumping of such a viscous substance as this gear lubricant, an easily volatilized liquid is mixed with it in order that a sufficiently fluid and thin mixture can be fed into the reservoirs of the automatic oilers. Immediately upon striking the relatively hot gears, the volatile component is vaporized, leaving the gear lubricant.

In installation and maintenance

of heavy machinery at Balmat, the engineer's transit is used to check parallelism of shafts, gear clearances, and bearing elevations, to eliminate as much as possible rule-of-thumb procedures. The transit has proved particularly useful in maintenance work on the rod and ball mills.

Rough on Classifiers

There are some interesting details behind the use of the Hardinge countercurrent classifier at Balmat. Originally a rake-type classifier was installed here. Frequently immense and numerous balls or segregations of magnetic material formed in the settling zone of the classifier, which thoroughly disrupted, snarled, and choked classifier operation, with sharply painful results to metallurgy.

The Balmat ore contains a small percentage of "magnetic" zinc, from 0.50 to 2.75 percent being the daily range. This magnetic material is a vexing source of trouble in flotation and is discussed more fully in the section on zinc flotation. The original classifier was driven through the load wheels. When this was found to be unsatisfactory for the heavy load encountered, a ring gear was installed. Further, the original classifier tires had to be substantially reinforced, whereupon classifier operation was entirely satisfactory. All balling up and segregation of magnetic material was eliminated, and classifier operation was restored to efficiency and tranquillity. A further advantage gained was the relative ease with which the classifier started under load after a shutdown as compared with the original rake-type classifier.

The Balmat grinding circuit is sufficiently flexible and provided with bypasses to make possible the cutting out of any apparatus in the grinding-lead flotation circuits quickly and easily and to continue operating at the appropriately adjusted rate of feed.

Zinc the Objective

Zinc is the chief product at Balmat and the flotation of sphalerite is the main concern. Balmat sphalerite is marmatitic, the clean mineral assaying 57 to 60 percent zinc. The chief gangue minerals are diopside and tremolite (22 percent); dolomite and calcite (20 percent); quartz (6 percent); true magnetite and hematite (2 to 3 percent); and chlorite and talc (5 or more percent).

The primary objective of Balmat flotation practice is to obtain the largest possible recovery of zinc in the form of concentrates assaying a minimum of 56 percent zinc and a maximum of 7.75 percent iron, by means of as simple a flowsheet as possible and at minimum cost. The secondary objectives are, first, to obtain the maximum recovery of lead as lead concentrate assaying a minimum of 60 percent lead, and the maximum recovery of pyrite as pyrite concentrate assaying 49 to 51 percent sulphur with a maximum of 3 percent zinc. As in all differential flotation plants, these objectives frequently are in conflict with each other. Generally speaking, in daily operation the primary objective, zinc recovery, is ever in view, but, nevertheless, the upsetting of the pyrite flotation by addition of excessive amounts of reagents or reagents that are harmful to pyrite flotation in the zinc circuit is avoided as much as possible.

In Balmat zinc flotation, there are two general schemes for flotation, which are called, for convenience, the high lime-sodium xanthate scheme and the low lime-sodium Aerofloat scheme. The terms "high lime" and "low lime" are relative only, the former meaning the addition of lime at the rate of 1.6 lb. per ton of ore, and "low lime" signifying the addition of 1.0 lb. of lime per ton of ore. In the high lime-sodium xanthate scheme, xanthate is used as the collector for zinc with little or no addition of sodium Aerofloat. In the low lime-sodium Aerofloat scheme, the Aerofloat is the chief collector for zinc, but in conjunction with varying amounts of xanthate.

"High Lime" vs. "Low Lime"

With the high-lime scheme the best zinc recoveries are made, but it is difficult to maintain the grade of zinc concentrate, and the pyrite flotation following suffers from the higher pulp pH due to the higher lime additions. Conversely, the low-lime scheme makes it easier to maintain grade of zinc concentrate and to keep up grade and recovery in pyrite flotation. On an average, the high lime-sodium xanthate plan works best under summer operating conditions, and the low lime-sodium Aerofloat plan works best under winter operating conditions.

Table 1, giving some metallurgical results obtained at Balmat during 1944 and 1945, should be studied, bearing in mind that the high lime-sodium xanthate plan was operative in 1944 and the low lime-sodium Aerofloat plan in 1945. It will also be observed from Table I that a lower total reagent cost per ton is possible with the high lime-sodium xanthate plan.

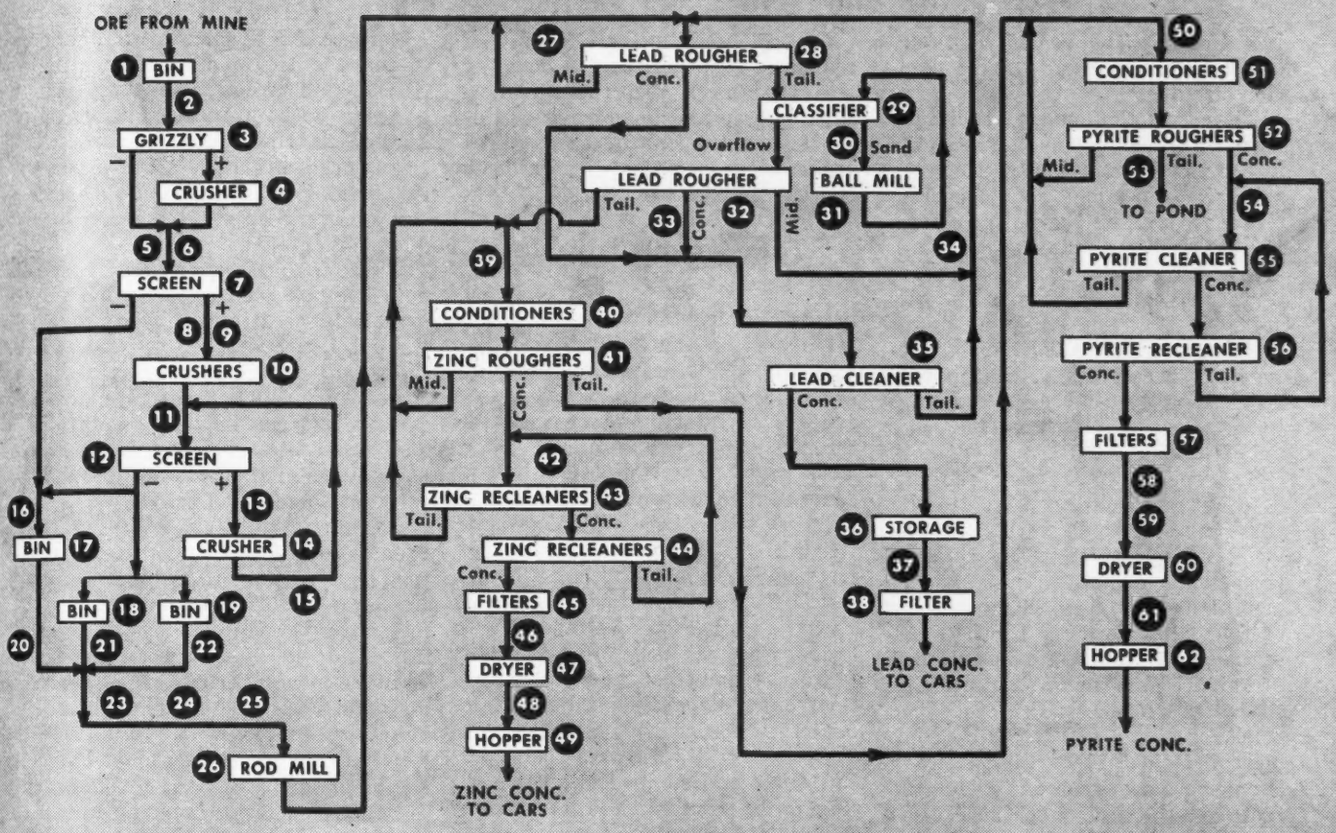
No attempt is made to make any fine adjustments in pH values in any of the flotation circuits. Regardless of the reagent scheme currently in use, the policy with lime is to add as much as the traffic will bear, the limit being that amount of lime which will so raise pulp pH as to cause pyrite recovery to drop below 75 percent. The lead circuit average pH value is 8.0 with 33 to 36 percent solids; the zinc circuit tailings average pH is 9.5 with 22 to 26 percent solids; the pyrite circuit tailings average pH is 9.0 with 13 to 16 percent solids.

What Operators Watch

A small cut is taken from the final zinc concentrates and run over a small shaker table. Flotation operators keep a constant eye on this table, chiefly for the purpose of maintaining grade of zinc concentrates. When the pilot table shows too much pyrite going into the zinc concentrate, a slight reduction in the amount of collector in the zinc circuit is made. If successive small cuts in the Aerofloat or xanthate fed to the zinc circuit fail to eliminate the excessive pyrite, a small increase in lime may be made.

In the meantime, the operator has been making frequent hand pannings of the zinc-circuit tailings, of the pyrite concentrates, of final tailings, and of concentrates drawn from several points along the zinc-rougher flotation machines. The operator notes the color of the pulp and consults with the rod-mill operator as to the color, richness, and nature of the ore. If several cuts in collector and several increases in lime to the zinc circuit fail to eliminate excess pyrite from the zinc concentrate, and at the same time hand pannings show zinc circuit tailings high in zinc and zinc content of the pyrite concentrates approaching the danger point, an increase in the amount of cyanide to aid in depressing pyrite in the zinc circuit and an increase in the amount of copper sulphate to aid zinc flotation are made. Rarely do these moves singly or in com-

ST. JOSEPH LEAD CO.—BALMAT MILL



LEGEND

1. Crude ore, 240 tons' live capacity
2. Jaw crusher feeders: one Stephens-Adamson apron feeder, 36 in. x 5 ft. 2 in., ratchet-and-pawl, 5-hp. motor; one belt conveyor, 36 in. x 16 ft., 15.75-deg. incline, 136 fpm, 5-hp. motor
3. Bar grizzly, slope 40 deg. from vertical, 60-lb. rail, 1⅞-in. opening
4. Allis-Chalmers Superior jaw crusher, 36 x 24 in., 3-in. discharge, 211 rpm, flat-belt drive, 75-hp. motor
5. Belt conveyor, 24 in. x 41 ft., 15-deg. incline, 225 fpm, 7½-hp. motor. Cutler-Hammer 30-in. circular lifting magnet at head pulley
6. Belt conveyor 24 in. x 476 ft., 8.75-deg. incline, 223 fpm, 20-hp. motor. Cutler-Hammer 39-in. circular separator magnet
7. Niagara standard No. 4 vibrating screen, 4x6 ft., ½-in. or ⅜-in. openings, 20-deg. slope, 1,150 rpm, 5-hp. motor
8. Belt conveyor, 18 in. x 31 ft., horizontal, 202 fpm, 2-hp. motor
9. Hopper, 5 tons' live capacity
10. Two 6-in. gyratory crushers, 573 rpm, V-belt drives, 50-hp. motors
11. Bucket elevator, vertical, 18 in., 50 ft. 4 in. ctr. to ctr. head and boot pulleys, 83 malleable iron buckets 16x8x8½-in., 16-in. spacing, 400 fpm, 30-hp. motor
12. Three vibrating screens: two Niagara single-deck standard No. 4 and one Tyler-Niagara, all 4x6 ft., 20-deg. slope, 1,031 rpm, V-belt drive, 3-hp. motors, ½-in. openings
13. Belt conveyor, 24 in. x 40 ft., horizontal, 187 fpm, 5-hp. motor
14. Traylor rolls, 57 in. diameter x 18 in. face, 40 rpm, two 75-hp. motors
15. Belt conveyor, 24 in. x 31 ft., 12.33-deg. incline, 208 fpm, 5-hp. motor
16. Belt conveyor, 18 in. x 41 ft., 14-deg. incline, 208 fpm, 5-hp. motor
17. Fine-ore bin, 600-ton, cylindrical, 45-deg. cones top and bottom, 26 ft. diameter x 33 ft. 9 in.
18. Fine-ore bin, 100-ton, cylindrical, 45-deg. cone bottom, 16 ft. diameter x 20 ft.
19. Fine-ore bin, 150-ton, cylindrical, flat bottom, 16 ft. diameter x 20 ft.
20. Belt conveyor, 24 in. x 39 ft., 18.5-deg. slope, 59 fpm, 5-hp. motor
21. Belt conveyor, 24 in. x 11 ft. 6 in., 16.25-deg. incline, 31 fpm, 1-hp. motor
22. Belt conveyor, 24 in. x 8 ft., horizontal, 31 fpm, 1-hp. motor
23. Belt conveyor, 18 in. x 40 ft., 20.5-deg. incline, 184 fpm, 5-hp. motor
24. Merrick Weightometer, Model E, feed rate 52 tons per hr.
25. Belt conveyor, 18 in. x 29 ft., horizontal, 145 fpm, 2-hp. motor
26. Allis-Chalmers special 6 ft., 6 in. x 12 ft. rod mill, rod load 55 percent of inside volume, 2½ in. x 12 ft. rods, 16.5 rpm, C-H magnetic clutch, 240-hp. 2,200-v. synchronous motors
27. Wilfley sand pump, 4-in., 900 rpm, 20-hp. motor
28. First lead roughers, St. Joe pneumatic, 36 ft. 6 in. long, 18-in. pipe header, 48 down pipes, 3-in., flattened at end to ¼-in. slots. Ingersoll-Rand blower delivers 5,400 cfm air at 1½ psi with 3,530 rpm, 50-hp. motor
29. Hardinge countercurrenf classifier, 8x20 ft., 1 to 12 incline, 1.47 rpm, 7½-hp. motor
30. Screw conveyor, 1½ to 1 incline, 12-in. flights, 16 ft. 4 in. long. 59.4 rpm, 10-hp. motor reducer, and roller chain drive
31. Allis-Chalmers ball mill, 6x8 ft., 26,000 lb. of 2½-in. triple-forged steel balls; 24 rpm, 125-hp. motor
32. Second lead rougher; same data as No. 28
33. Wilfley sand pump, 4-in., 1,150 rpm, 10-hp. motor
34. Wilfley sand pump, 4-in., 900 rpm, 20-hp. motor
35. Denver Sub-A 4-cell machine, 42x43-in. cells, 254 rpm, 5-hp. motor. Each cell's froth feeds next cell; each tailing returns to cell ahead; final cleaner tailing leaves first cell, final concentrate leaves last cell
36. Three lead concentrate storage tanks; 10 ft. x 8 ft. 7 in.; and two 12 ft. x 6 ft. x 5 ft. 9 in.
37. Wilfley sand pump, 2-in., 1,200 rpm, 5-hp. motor
38. Dorrco filter, Type BMBC, 8x14 ft., 0.75 rpm, 3-hp. motor
39. Wilfley sand pump, 6-in., 900 rpm, 50-hp. motor, plus 4-in. Wilfley helper
40. Two Denver conditioners in series; one 12 ft. x 11 ft., 4 in. one 9 ft., 6 in. x 11 ft. 4 in., both 162 rpm, 5-hp. motor
41. Six zinc roughers, in parallel; each is St. Joe pneumatic type; same data as No. 28
42. Wilfley sand pump, 4-in., 900 rpm, 20-hp. motor
43. One two-cell Denver machine, 43x43-in. cells, double overflow, 250 rpm, 5-hp. motor
44. Two two-cell Denver machines in parallel, each same as No. 43. Each overflow of No. 43 feeds one machine of No. 44
45. Two Dorrco filters, Type BMBC feeds one 12x16 ft., one 8x14 ft., both 0.75 rpm, 3-hp. motors
46. Belt conveyor, 18 in. x 19 ft., horizontal, 173 rpm, 2-hp. motor
47. Ruggles-Coles dryer, 54 in. x 26 ft., 7.5 rpm, 15-hp. motor, coal-fired; exhaust fan and dust cone
48. Belt conveyor, 16 in. x 79 ft., 50 ft. inclined at 20.5 deg., and 29 ft. horizontal, 146 fpm, 5-hp. motor
49. Hopper, 15-ton, Syntron vibrator. To cars via S-A box-car loader. Daily shipments to smelter at Monaca, Pa.
50. Wilfley sand pump, 6-in., 900 rpm, 50-hp. motor. Helper pump, 4-in. Wilfley
51. Three Denver conditioners in series: A, 11 ft. 6 in. diameter x 11 ft. 4 in.; B and C, 12 ft. x 11 ft., 4 in.; A and C, 162 rpm, 5-hp. motor; B, 202 rpm, 10-hp. motor
52. Five pyrite roughers in parallel. Each is St. Joe pneumatic type, same data as No. 28 except I-R blowers here each delivers 4,200 cfm air at 1 psi, with 3,545 rpm, 40-hp. motor
53. Wilfley sand pump, 6-in., 900 rpm, 9-ft. vertical lift to 8-in. wooden-stave tailing line. Also one spare 6-in. Wilfley
54. Wilfley sand pump, 4-in., 900 rpm, 15-hp. motor
55. Two two-cell Denver machines in parallel, each cell 43x43-in., double overflow, 250 rpm, 5-hp. motor
56. Two two-cell Denvers in parallel, same data as No. 55. Overflows from No. 55 joined; then split to feed No. 56
57. Two Dorrco filters, Type BMBC; 12x16 ft. and 8x14 ft., both 0.75 rpm.
58. Belt conveyor, 16 in. x 30 ft., 16 ft. at 1½ in. per ft. and 14 ft. horizontal, 120 fpm, 2-hp. motor
59. Belt conveyor, 16 in. x 18 ft., horizontal, 120 fpm, 2-hp. motor
60. Ruggles-Coles dryer, 5x35 ft., 7 rpm, 15-hp. motor, coal-fired, exhaust fan and dust cone
61. Belt conveyor, 16 in. x 96 ft., 59 ft. inclined at 16.75 deg. and 37 ft. horizontal, 146 fpm, 3-hp. motor
62. Hopper, 15-ton, Syntron vibrator. Via S-A portable loader to cars for daily shipment to General Chemical Co., North Claymont, Del.

bination fail to remedy an unhealthy condition of the zinc flotation circuit.

These are the changes that may be made to correct maladjustments in the zinc circuit, but superior results are dependent not on corrective moves but on preventive moves. For this reason, flotation operators are trained and instructed to observe all slight changes in the circuits and to do their panning whether or not the flotation is proceeding successfully. In this way adjustments may be made before the zinc circuit becomes seriously unbalanced.

The speeds of the zinc rougher flotation machines are regulated by changing the pulp levels at the weirs, and secondarily by adjusting the amount of pine oil. Usually copper sulphate is raised when the color of the pulp is a dirty brown, indicating more than the usual amount of oxidation in the ore and possible slime interference. On occasions, small amounts of Red oil (commercial oleic acid) are added as a supplementary frother when the froth on the zinc machines seems particularly slow and sluggish, but because of its adverse affects on filter canvases, the use of this reagent is avoided as much as possible.

Frequently Dresinate XXX is added in small amounts (0.01 to 0.025 lb. per ton) to the zinc circuit. The advantages of Dresinate XXX are that it increases zinc recovery by a small amount and decreases over-all reagent cost by permitting a substantial cut in pine-oil requirements. Its chief disadvantage is its power to pull insolubles into the pyrite concentrate, seriously lowering the grade. For this reason, it is used with great caution, and its possibilities in the zinc circuit probably have not been fully realized. This is one example of not upsetting the pyrite flotation by the addition of an excess of a reagent in the zinc circuit which is harmful to the following pyrite flotation.

Operators Have Leeway

Flotation operators are permitted to make whatever adjustments are necessary in the quantities of reagents added to the three flotation circuits within the limit of proved practice. In return, they are expected to report faithfully and truthfully all reagent changes made during their shifts in order that metallurgical results may be closely coordinated with reagent practice.

Central handling and feeding of reagents is practiced, in keeping with the aim to keep the mill flowsheet simple and unadorned. Table III is a statement of the present reagent consumption in the lead, zinc, and pyrite circuits.

Talc Makes Trouble

There are two more items of practical importance in the operation of the zinc flotation circuit. The first concerns the handling of accumulated dust from the dust-collecting system, and the second, the clean-up of wash sumps. New York state law requires that dust counts at all working places be kept below a certain safe maximum. Accordingly, dust-collecting equipment has been installed in the primary and secondary crushing plants. Every day, 900 lb. of dust is collected, the dust assaying somewhat higher in zinc than the regular mill feed, but considerable higher in talc content.

Formerly this dust was collected in a sump and pumped into the regular mill circuit when the sump became full. The effect of the high talc content of this dust was to make the zinc and pyrite froths run wild, seriously interfering with the selectivity of the zinc circuit. In a short time, every launder and pump box in the zinc circuit would be running over, due to the voluminous talcky froth produced. The zinc content of the dust was not being saved, and worse, zinc in the regular feed was being lost. Finally it was decided to flush the dust directly from the dust bins to the tailings pump box, avoiding thereby periodic sessions with maverick flotation circuits. In this abrupt fashion, the talcky dust was eliminated as a factor in zinc flotation.

Secondly, the matter of sump clean-up. Launders will overflow, pump boxes will run over, filtrates must be pumped into a sump before being discarded, power will kick off, and flotation machines must be washed out at the end of each operating week. This all means a collection of miscellaneous products from different points in three flotation circuits, in sumps. At Balmat there are two wash sumps of 515- and 720-cu.ft. capacities. Sump overflow runs to waste. On an average, one of these two sumps is washed out each week. Sump material is pumped to the Hardinge classifier. By a drastic reduction in the amount of pine oil, complete elimination of xanthate and Dresinate XXX, and by a liberal increase in the amount of lime fed to the zinc circuit, the sump run is made without too serious a reduction in the grades of concentrates or recoveries. It takes from two to four hours to clean out each sump. Every effort is made to reduce spillage.

Up to now, the discussion of zinc flotation has been purely from the practical operating point of view. Behind the operating factors are the basic metallurgical characteristics of the Balmat ore. The chief factors in successful zinc flotation at Balmat are pulp temperatures, amount of magnetic zinc, and nature and fineness of grind.

Sphalerite floats with much greater reluctance in pulps of low temperature than in pulps of high temperature. As soon as Balmat mill water drops to 50 deg. F., some difficulties in zinc flotation begin. Winters in northern New York are long and severe. The Balmat source of water for milling is Sylvia Lake, a half mile west of the mill. From the middle of November to the first of May, the water temperatures are below 50 deg. F., the low point being 35 deg. F., a condition which persists from the middle of December to the end of March.

Temperature vs. Recovery

The over-all effect of low water temperature is to reduce zinc recovery by 1 to 2 percent and to increase reagent cost by 1 to 2c. per ton. The possibility of heating water for zinc flotation during the winter months has been studied, with the conclusion that it would not be an economic procedure. Formerly, during winter months large tonnages of pyrite concentrate with zinc content too high for shipment were stockpiled, then later mixed with high-grade pyrite produced during the summer months to obtain a product meeting specifications. But now the need for stockpiling off-grade pyrite has been practically eliminated by improved metallurgy, chiefly by more skillful manipulation of flotation reagents and more complete acquaintance with the nature of the ore and its flotation characteristics in low-temperature pulps. The difference between zinc recovery in summer and winter has been constantly whittled down, but it is still there, and therefore persistent efforts are made to reduce it.

During the 1945-46 winter season, not one ton of off-grade pyrite

Table I. Metallurgical Results, Balmat Mill

	Summer Conditions Sept. 1945	Average 1945	Winter Conditions Jan. 1945	Average 1944
Daily crude-ore tonnage	1,012	973	1,066	1,133
Crude-ore assays				
Lead, %	0.43	0.61	0.65	0.75
Zinc, %	9.02	8.92	9.61	9.72
Pyrite iron, %	9.86	10.22	11.02	10.36
Lead products				
Concentrates, lead, %	64.20	60.98	58.30	60.46
Tailings, lead, %	0.17	0.22	0.22	0.15
Zinc products				
Concentrates, zinc, %	57.14	56.77	56.74	56.04
Zinc circuit tailings, zinc, %	0.89	1.08	1.46	0.92
Pyrite products				
Concentrates, pyrite iron, %	42.50	40.89	39.80	40.70
Concentrates, sulphur, %	50.51	49.20	48.61	48.91
Concentrates, zinc, %	1.54	2.24	3.44	1.89
Pyrite circuit tailings, pyrite iron, %	1.92	2.77	4.80	3.06
Recoveries				
Lead in lead concentrates	63.10	61.75	57.51	72.72
Zinc in zinc concentrates	93.02	90.19	88.61	92.28
Pyrite in pyrite concentrates	85.65	80.15	68.16	77.12
Total reagent costs, cents per ton	16.77	17.70	18.65	16.45

Daily crude-ore tonnage average for 1945 low because mill operated for twelve days at less than half tonnage while major repairs were made in grinding circuit.

During 1945 used low lime-sodium Aerofloat scheme for zinc flotation.

During 1944 used high lime-sodium xanthate scheme for zinc flotation.

Table II. Comparison of Reagent Costs, Summer and Winter Operating Conditions

	Summer May to Mid-Nov., Incl.	Winter Jan. to April, Incl. Mid-Nov. to End of Year
1944	16.36c. per ton	16.53c. per ton
1945	16.50c. per ton	19.06c. per ton

Table III. Current Reagent Consumption, Balmat Mill

	Lb. per Ton of Ore
Lead circuit	
Sodium xanthate	0.015
Sodium cyanide	0.051
No. 31 Aerofloat	0.039
Zinc circuit	
Sodium xanthate	0.031
Copper sulphate	1.537
Pine oil	0.295
Sodium Aerofloat	0.124
Lime	1.015
Dresinate	0.010
Pyrite circuit	
Sodium xanthate	0.205
No. 31 Aerofloat	0.039

The above figures are averages for December 1945 and January and February 1946. They represent the low lime-sodium Aerofloat scheme of zinc flotation for winter operating conditions. Under the same plan, reagent consumption for summer would vary from the winter figures as follows: Copper sulphate 1.1 to 1.3 lb. per ton; pine oil generally higher, 0.35 to 0.45 lb. per ton; Dresinate XXX, 0.015 to 0.025 lb. per ton; lime, 0.9 to 1.0 lb. per ton; Aerofloat, 0.06 to 0.12 lb. per ton; xanthate, 0.03 to 0.06 lb. per ton.

Table IV. Screen-Chemical Analyses of Zinc-Circuit Tailings

Size Tyler Mesh	Sept 1945 % Weight	Sept 1945 % Zinc	Average, 1945 % Weight	Average, 1945 % Zinc	Jan. 1945 % Weight	Jan. 1945 % Zinc	Average, 1944 % Weight	Average, 1944 % Zinc
Plus 48	8.3	0.88	9.4	1.08	11.7	1.52	11.4	1.45
Plus 65	11.7	0.94	10.8	1.11	11.0	1.80	10.5	1.25
Plus 100	17.2	0.78	19.1	1.06	20.2	1.80	20.8	0.88
Plus 150	13.7	0.62	12.7	0.79	11.8	1.19	11.3	0.54
Plus 200	11.1	0.52	10.1	0.53	8.7	1.09	10.3	0.36
Minus 200	38.0	1.21	37.9	1.35	36.6	1.54	35.7	1.28

Daily tonnages, Sept. 1945, 1,012; Sept. 1944, 973; Jan. 1945, 1,066; Jan. 1944, 1,133.

Table V. Screen Analysis of Crude Ore Feed to Rod Mill

Size, Tyler Mesh	% Weight	Cumulative % Weight
Plus 0.505 in.	0.0	0.0
Plus 0.371 in.	4.8	4.8
Plus 3 mesh	13.7	18.5
Plus 4 mesh	14.0	32.5
Plus 6 mesh	7.5	40.0
Plus 8 mesh	8.1	48.1
Minus 8 mesh	51.9	51.9
Total	100.0	100.0

concentrate was made, and metallurgical results closely approached those obtained under summer operating conditions. Table I shows clearly the difference between summer and winter practice. It should be pointed out, however, that the examples chosen depict the extreme differences that may be obtained, not the average. A good average figure for zinc recovery during summer months would be 91 percent, and for winter 89.5 percent. It is expected that the finer grind obtainable in the new crushing plant will make possible a still smaller difference between winter and summer results.

Magnetic Zinc

Magnetic zinc is simply a fine intergrowth of magnetite and sphalerite, very much too fine to be liberated by any economic grind. It is an unmitigated nuisance. It will not float in the zinc circuit, though sometimes it will float in the pyrite circuit. The magnetic content of the ore at Balmat will vary from 0.50 to 2.75 percent, and the magnetite-sphalerite intergrowth will assay 35 percent zinc, upon being analyzed.

When magnetic zinc makes its appearance in the ore, not much can be done about it. The Balmat mill is a sulphide flotation mill, and is not set up to recover magnetic and non-metallic minerals. There is no doubt that magnetic zinc could be recovered as a separate product in the mill if such a move were warranted. This would mean additional equipment to recover and handle this product, which would be contrary to one of the key objectives in the operation a simple mill. There would then be on hand each day from 5 to 25 tons of low-grade zinc concentrate, assaying 30 to 35 percent zinc, which experience has shown would be most difficult to sell.

Improving the Grind

The third important metallurgical factor in successful zinc flotation at Balmat is the character of the grind. On the whole, satisfactory metallurgy is obtained at a relatively coarse grind, 10 percent plus-48 mesh and 37.5 percent minus-200 mesh sufficing to give 90 percent or better zinc recovery. Weekly screen-chemical analyses of the zinc circuit tailings show that the lowest zinc tailings are obtained in the minus-100 mesh plus-200 mesh fraction, and that the highest zinc tailings are found in the plus-48 mesh and the minus-200 mesh fractions. As mentioned before, zinc recovery is expected to improve in the plus-48 mesh range simply by reducing the amounts of plus-48 mesh material to less than 5 percent by means of an eventual finer grind.

Improvement in zinc recovery in the minus-200 mesh range is

doubtful. Photomicrographic studies of zinc tailings of this size show numerous middlings of pyrite-sphalerite, hematite-sphalerite, gangue-sphalerite, and combinations of these groups, which could not be liberated into free components by any reasonably economic grind. Accordingly, the possibility of a zinc middling regrind circuit has not been seriously considered. Table IV gives screen-chemical analyses of zinc circuit tailings during 1944 and 1945 and shows clearly the distribution of zinc losses in the various sizes.

Pyrite Comes Last

A liberal amount of sodium xanthate is added to the zinc circuit tailings, together with a small amount of No. 31 Aerofloat frother-collector, to effect the flotation of pyrite. The aim in pyrite flotation is to make a concentrate assaying 49 to 51 percent sulphur and less than 3 percent zinc, at 75 percent minimum pyrite recovery. However, the zinc content of the pyrite concentrate depends upon the successful removal of all flotable zinc in the preceding zinc circuit, since the heavy concentration of collector in the pyrite machines will certainly recover any floatable zinc that escapes the zinc section.

Undoubtedly, an increase in the recovery of pyrite could be achieved by adding sufficient sulphuric acid to reduce the pH value of the pulp to some lower point more favorable to pyrite flotation. But here, effort to perfect the technique must give way to the constant pressure of cost-in-cents-per-ton metallurgy. Balmat pyrite concentrate is a source of sulphur; it contains no gold or silver to warrant special treatment. An excess of lime and cyanide, depressors of pyrite, and of Dresinate XXX, which floats silicate minerals in the pyrite circuit, is avoided as much as possible in the preceding lead and zinc cells, but that is all that can be done to favor pyrite flotation.

Filters Only

Zinc and pyrite concentrates are filtered to Dorrco filters without preliminary thickening. These concentrates leave the re-cleaner machines at 60 percent solids, and arrive, by gravity flow, in the filters at 40 to 45 percent solids. The objections to thickeners are that they require large building space expensive to heat in the winter, they would mean added equipment in the flowsheet, and finally that thickeners would not operate efficiently in winter with mill water temperatures 35 to 40 deg. F. For filtering a rather coarse and easily filtered concentrate, the figure 35 to 40 percent solids is not too low. Due to small daily production, lead concentrates are stored in tanks until a carload has accumulated, whereupon the contents of the storage tanks are pumped to a Dorrco filter for dewatering.

The zinc and pyrite filter circuits both have an 8-ft. diameter by 8-ft. tank for emergency storage of concentrates if mechanical difficulties develop in the filter circuits or the following dryer circuits, or if there is a temporary shortage of box cars for loading. In addition, a large outdoor storage space for pyrite is maintained for use when a serious shortage of box cars exists, or to store off-grade pyrite. Pyrite concentrate is routed to the stockpile by pumping and returned to the pyrite filters by sluicing and pumping when conditions are favorable in the summer.

Altered Dryers

Zinc and pyrite concentrates are dried in coal-fired Ruggles-Coles dryers, the zinc to 3.5 percent average moisture and the pyrite to 3.0 percent maximum moisture. Lead concentrates are shipped without further treatment after filtering. Each dryer fan exhausts into a cyclone dust collector which discharges dust concentrate on to the respective conveyor belt from dryer to loading shed. The dryer room is well ventilated by means of two Propellaire ventilators.

The original Ruggles-Coles dryers were replaced after 15 years of service by two similar dryers with locally designed and made improvements. The two new dryers have the following mechanical points of interest, which were introduced as a result of previous experience with the older dryers: (1) The pyrite dryer shell is completely lined with ⅝-in. steel plate. The zinc dryer shell thickness is 1 in. for the first (hot) third of its length, ¾ in. for the second third, and ½ in. for the final third of its length. The objective of the different shell thicknesses is to compensate for the unequal wear of the shell in the ratios indicated by the three shell thicknesses. (2) A beveled horizontal thrust roller is maintained against an extra beveled tire at the middle of the dryer to resist end thrust. (3) Tire roller shafts are stationary, the roller-bearing-equipped rollers rotating about the shaft. (4) Automatic oiling with Manzell oil pumps is used throughout. (5) Exhaust pipes from fan to dust cones have been covered with 1½-in. coatings of heat-insulating cement to prevent condensation of moisture, especially during the prolonged winter period, in the exhaust pipes and cones.

Tailings Guide

Final tailings from the pyrite flotation circuit are pumped through an 8-in. wood-stave pipe to the tailings pond. At Balmat, practice for tailings disposal is guided by three cardinal principles:

1. Avoid dips and irregularities of slope in the stave line assiduously, to prevent plugging, followed by freezing in the winter. Uniformity of slope is obtained by checking with a transit at frequent points along the line during installation.
2. Tailings pipe is laid as straight as possible. Curves, wherever unavoidable, are made long and sweeping.
3. Prepare in summer for tailings disposal in the winter. This principle is probably the most important of the three.

Shipping the Product

All concentrates are shipped in box cars. Zinc and lead concentrates are loaded into the cars to measured level heights, and pyrite is loaded by Weightometer count. The pyrite Weightometer is adjusted by daily railroad weight reports on loaded box cars, since the conditions of dust, humidity, and temperature are not favorable for the usual precise functioning of the Weightometer. Stephen-Adamson portable box-car loaders are used to transfer concentrate from hopper chute to box car. Hand car-jacks are used to move box cars, empties and loaded, into and out of the loading shed, although two electric tugger hoists are available for the purpose.

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Georgia Talc Industry Helped by Geologic Study

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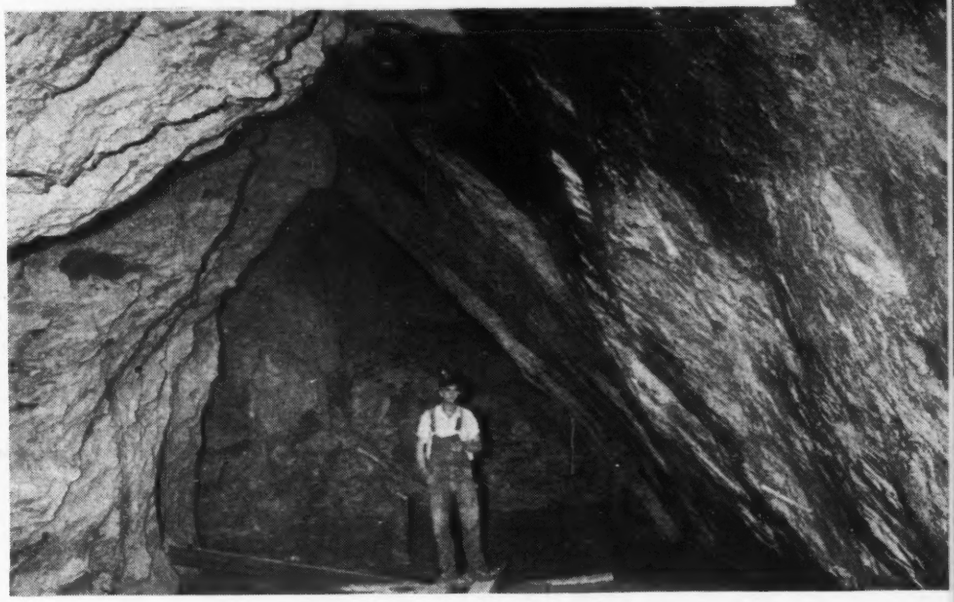
A study of the talc industry in Murray County, Ga., has been made by Georgia's Department of Mines, Mining, and Geology and the Tennessee Valley Authority Commerce Department. Maps of the four active mines were prepared. The areal geology of the region and underground geology of the mines were mapped by Dr. A. S. Furcron and Mr. Teague. Data for this paper were obtained in the course of this work. Mr. Teague has attempted to avoid duplication of information which has already been presented in a previous article[1].



NORMAL FAULT on fourth level of Southern mine. Hanging wall is on right. On the footwall is 4 to 6 ft. of crayon talc.

TALC PRODUCTION in Georgia at present is limited to that from the Chatsworth district in Murray County, in the northern part of the state. The mining and milling of this mineral have been important industries in this region for about fifty years. The producing area lies on the western edge of the Older Appalachian Mountain Province, near the southern terminus of the Great Smoky Mountain range. In the area mentioned the talc is obtained from a number of deposits which occur along the southern and western slopes of Cohutta Mountain and the western and northern slopes of Fort Mountain, three to six miles east of Chatsworth, the county seat. The talc mills are situated directly on the Louisville & Nashville Railroad in the town itself.

They are three in number—namely, the Southern and the Georgia plants, owned and operated by the Georgia Talc Co., which is managed by M. Woodard Glenn, and the Cohutta mill, owned and operated by the Cohutta Talc Co., of which Floyd F. Farrar is in charge.

Current production of talc comes from four mines. The Georgia mine, owned by Georgia Talc Co., supplies the Georgia mill; the Southern mine, leased by the Georgia company, provides the raw material for the Southern plant; and the Cohutta and Fort Mountain mines, owned and operated by the Cohutta Talc Co., supply talc for the Cohutta mill. A "saw line" for sawing crayons is operated by the Cohutta company at its plant, and a line at the Georgia mill saws the talc of crayon grade obtained in the Georgia and the Southern mines. James Chambers is mine superintendent for the Cohutta company, and Francis Glenn is in charge of the Georgia company's mines.

A New View Is Taken of the Geology

The geology of the talc deposits has been studied, and the findings are to be published as a bulletin of the Georgia Geological Survey. Previous writers have regarded the talc as occurring in the Ocoee Series, consisting of slates, arkoses, and quartzites. Actually it occurs as lenses in association with dolomitic and chloritic schists which have been intruded by and included in a Pre-Cambrian granite gneiss. Thus the talc appears to have been derived from alteration of impure dolomitic limestone of Pre-Cambrian age.

Talc in Two Belts

Twenty occurrences of talc are known along two belts of granite gneiss. The western of these belts has three large mines opened in it, all at about 1,100 ft. above sea level, or about 300 ft. higher than the mills at Chatsworth. The eastern belt of talc-bearing rock, at 1,600 to 1,900 ft. elevation, is about 12 miles long. Here numerous prospects and mines have been opened. The deposits do not appear to occur at any definite zone or horizon; however, all of the known occurrences are inclosed by granite or granite gneiss.

Local topographic features have been of major importance in the discovery of the deposits. Talus

[1] Hubbell, A. H.: "Talc From North Georgia," E. & M. J. Vol. 143, Nov. 1942.

fans from the massive quartzite beds which cap the mountains to the east cover more than one-half of the talc-bearing formation, so that only in the younger valleys where this talus material has been removed is the bedrock exposed. Thus all of the talc openings in the past have been confined to the young valleys or their walls.

The talc outcrop consists of a talc-chlorite schist, as a rule badly iron-stained. The more soluble carbonates have been dissolved in the weathered zone. Serpentine, generally resistant to weathering, is not noted at the surface, probably because it is so thoroughly mixed with dolomite that it disintegrates in the weathering zone by solution of the more soluble carbonates.

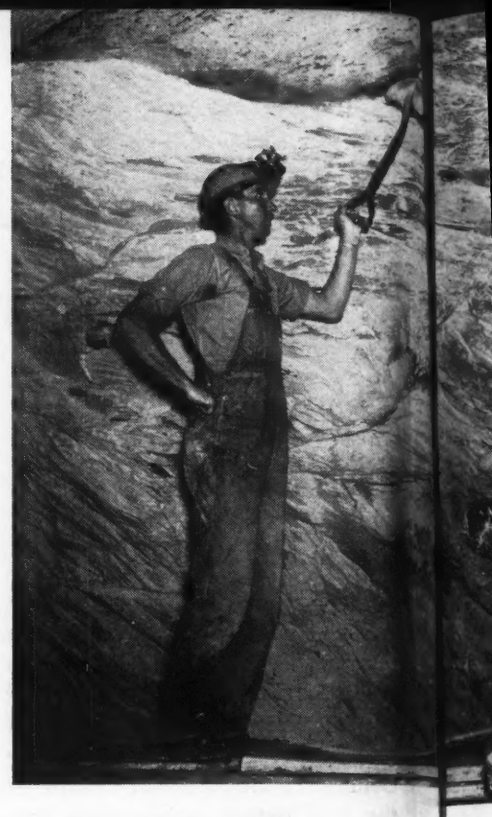
The Largest Known Lens

Much variation is noted in the size and mineral character of the talc lenses. The largest known lens has been opened in the Georgia mine and the old Cohutta mine (now inactive). It is almost a mile long and possibly 150 ft. thick. It has been worked down the dip for more than 250 ft., and present indications are that it will persist to greater depth. Generally speaking, the larger lenses are more impure than the smaller ones and may contain granite inclusions. Associated with the talc, listed in order of abundance, are more or less serpentine, chlorite, and dolomite, and generally minor amounts of actinolite, anthophyllite asbestos, chrysotile asbestos, pyrite, magnetite, apatite, and zircon.

May Aid in Finding Talc

Certain features common to most of the talc deposits studied suggest possible methods of predicting the position of various grades of talc. The interior structure of the lenses is complicated. The general or over-all structure of the principal producing deposits is determined by thrust faults which may come into actual contact with talc ore.

The interior structure of the talc-bearing zones is also dominated by slipping and movement. Evidently, stresses which did not especially affect the massive inclosing rocks were released in movement because of the "lubricating" features of talc. Serpentine-dolomite boulders of all sizes dominate the interior structure and thus determine the plan of the mine. Crayon talc, a sort of "talc mylonite," locally enwraps these boulders. Crayon talc and "Blue John" seem to be related to the more sheared zones, and thus are common to the walls (both foot and hanging) of the deposits and also tend to inclose the serpentine-dolomite boulders. "Blue John," however, contains other minerals in addition to talc and is too hard to saw. The serpentine masses are smooth, round, frequently slickensided on their exterior, and the schistose talc ends abruptly against them locally. The serpentine masses show indications of having been moved and "smeared" about in the deposits. Although apparently quite massive, they are slickensided in their interior.



A 4-FT. ZONE of crayon talc inclosed by white grinding talc at the Fort Mountain mine of the Cohutta company.

Normal faults occur. They may be traced along the strike for distances of several hundred feet, but it is difficult to determine their throw; however, it appears to be small, since they cause little trouble in mining.

Various Grades

As pointed out, crayon talc occurs along both walls of the deposits and the more highly sheared zones in the interior part of the lenses; thus when crayon talc alone is wanted, mining should be confined to these areas. Talc suitable for making the better grades of powder is obtained from those portions of the deposits where the movement has been considerable but not sufficient to produce the straight schistosity required for crayon talc. The serpentine-dolomite boulders may be mined and ground for roofing material. As is to be expected, more talc ore of the serpentine-dolomite type is present than any other. If mining is to be efficient and systematic, the producer must have a market for all the various grades of talc present in the deposits.

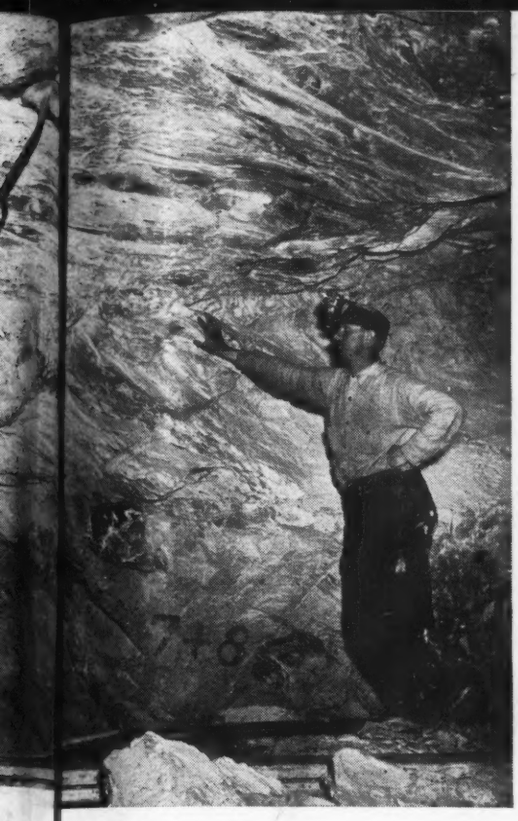
Mining Is Simple

Earliest mining was confined to working the outcrop, and the talc thus obtained was stained by surface weathering. Mines are now opened by driving an adit into the footwall of the lens so that the talc deposit is encountered well below the stained zone. The adits have enough slope (1 percent) so that mine cars will roll by gravity. These entries are generally made in granite and require little timbering. The mines have only one haulageway, this using a 16-in. to 24-in. gage track and which in general is crooked, preventing rapid handling of cars. From the main entry, after the talc has been cut, an incline is put down and stoping levels are turned off on either side. Locally the plan of the levels is confusing because the search is generally for crayon talc, little attention being given to systematic mining.

General practice is to use gasoline-driven hoists underground in those mines which have good ventilation and to use air hoists underground or hoists operated from surface where ventilation is poor. It would be advisable to eliminate the use of gasoline motors underground entirely.

Stoping Mostly Overhand

In general, the talc is mined by overhand stoping with a minor amount of underhand work. The miners usually choose the point for starting a stope upward from a level according to the presence of crayon talc. The practice is to remove the more impure talc used for making powder from underneath the crayon-grade material and then break the latter down so as to get the least shattering. The desired crayon talc usually makes up less than 5 percent of the production.



Usually, the roof stands well, and little timber is required. Only in areas of extreme faulting are timbers used. Except in periods of unusual rainfall, little water is encountered. In drilling in headings or stopes, light (40-lb.) hand-held jackhammers are used, or, as at the Georgia and Southern mines, the drill is held in a saddle.

Black Powder Used

Holes are usually 6 to 8 ft. deep and are loaded with black powder. This explosive is employed because it gives less fines and does not shatter the talc too badly. Fuse and caps are used to shoot the holes, which are so arranged as to give a "V"-cut for breaking. At the Georgia and Southern mines, broken ore is loaded by an air-operated Sullivan mechanical loader where possible. Elsewhere mucking is by hand. When the ore is broken in stopes, a mucking platform is generally built at the bottom and the ore is shoveled by hand into mine cars. Crayon talc is separated at the mine from the talc to be ground. Cars are trammed by hand to the bottom of the haulage incline.

The talc is hauled in company-owned 6-ton dump trucks from mine to mill. These trucks, when in continuous service, have a life of two to three years. Cost of hauling the crude talc ore from mine to mill is dependent upon the condition of the access roads and of the trucks.

Mill Flowsheets Similar

Similar methods are used at all three plants. The trucks dump the crude talc on a receiving floor, from which it is shoveled onto a belt conveyor which feeds a hammer-type primary crusher. The amount of breakage obtained here largely determines the efficiency of the mill as a whole. Crushed ore is elevated to bins, from which it is fed mechanically, or automatically as at the Southern mill, to the secondary machines. Roll mills or ball-and-hammer mills, as at the Georgia plant, are used for secondary reduction. Air is forced through at a controlled velocity, removing the finely ground talc. All secondary grinding is in closed circuit. Air from the mill elevates the fine talc powder to separators, where the talc and air are separated, the air being returned through the mill and the talc dust going to bins for bagging and shipment.

Recently a flash dryer was installed at the Southern mill for drying the ore, heretofore too wet to grind. Not only does this permit grinding ore which previously went to the dump when wet, but it increases the grinding rate for all the ore. The dryer consists of a large commercial General Electric burner equipped with various sizes of detachable burner tips. The burner is housed in an old 4x9-ft. cylindrical boiler lined with one layer of A. P. Green firebrick. The hot air is added to the air circuit just prior to its entering the mill. From three to six gallons of fuel oil are consumed per hour by the burner. Efficiency in grinding at the other two mills could be increased by installing a dryer similar to the one used at the Southern mill.

The Outlook Is Good

Production of talc in the southeastern United States is limited to two states—Georgia and North Carolina. With the present tendency towards a more uniform geographic distribution of talc-consuming industries and establishment of new branch plants in the South, these two states enjoy an advantage over others that produce talc. Climatic conditions in Georgia and North Carolina are such as to encourage mining at all seasons.

Certain features of this industry which in the past have caused inefficient operation are being corrected. Federal funds were recently made available for improvement of existing roads and construction of new access roads to the active mines. This will permit talc ore to be delivered to the mills during periods of heavy rainfall. Also, larger trucks can be used, thus lowering the hauling cost. Mine operators are making every effort to secure electricity for power at the mine. The Georgia mine appears likely to have it soon.

Better Mining Ahead

Operators realize that mining cost will be reduced and efficiency increased by use of systematic mining methods. The number of haulage adits should be increased to two at all the larger mines, at the Georgia and Cohutta particularly. Inclines should be straight, and of uniform grade to permit rapid hoisting. Past practice has been to have levels at too frequent intervals. To permit efficient stoping, they should be at least 60 ft. or more apart. If it is possible to obtain electricity, it should be used for underground lighting. Better lights would increase safety.

Ground talc as produced at present generally goes to the roofing, paint, or rubber industry. Within the past few years a greater amount of ground talc is being used as a carrier by the manufacturers of insecticides. Attempts to improve the grade of talc produced have been encouraging. If the talc can be made to meet the specifications for the textile and ceramic industries, the mills will be ideally located for supplying the demands of the southeastern states.

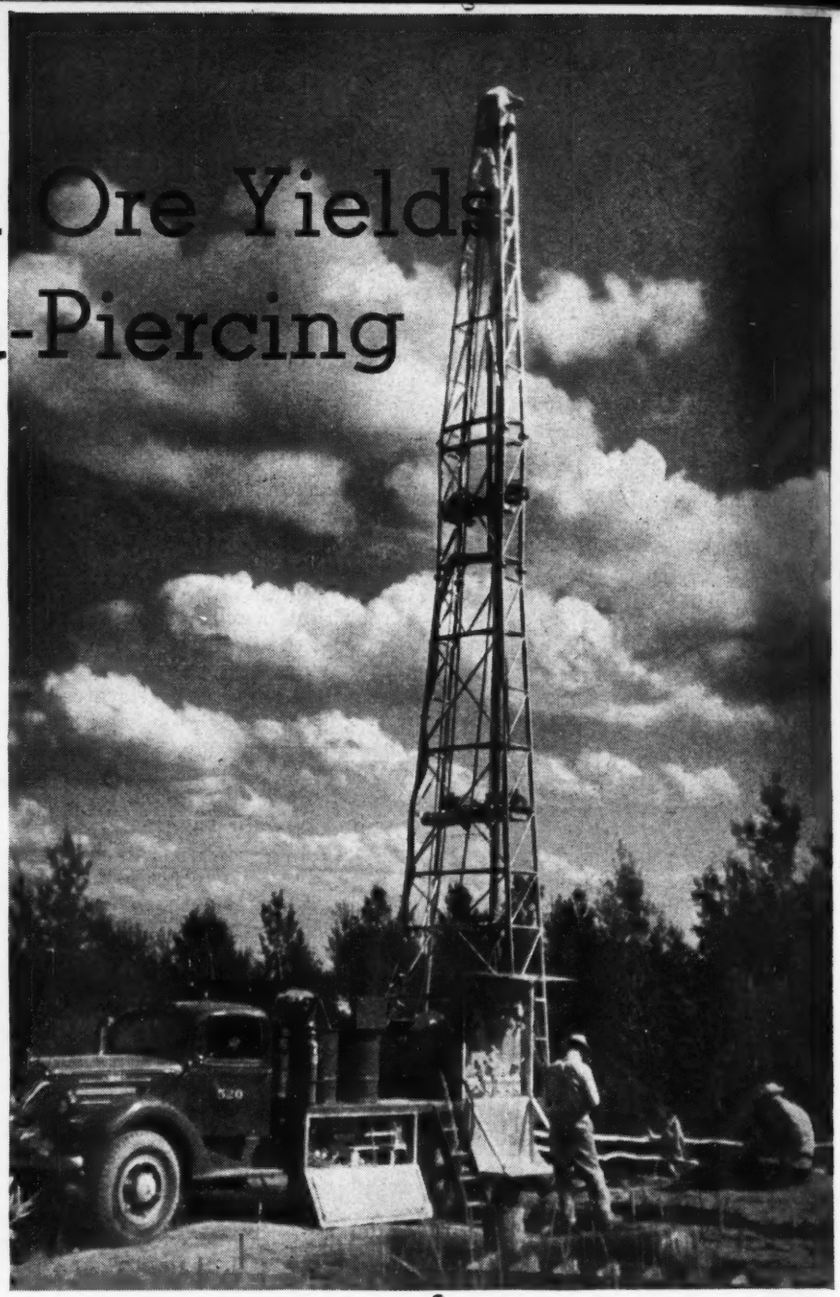
Demands by industry for ground and sawed talc should keep the plants operating at maximum capacity for several years. Chatsworth has long produced most of the metal worker's crayons consumed in this country, and it is believed that this condition will continue. Demand for ground talc is greater than can be filled at present. Underground reserves in mines now operated are adequate for at least 20 years and perhaps longer. Other known talc prospects in the district can be developed into mines should the milling capacity demand additional ore. With these factors in mind, the outlook for the Georgia talc industry is bright.

I take this opportunity to express my appreciation to the operators of the Georgia and Cohutta companies for their cooperation and permission to publish this information.

Hard Iron Ore Yields To Fusion-Piercing

ALVIN W. KNOERR
Associate Editor

A revolutionary method of making vertical blast holes, developed by The Linde Air Products Co., is described in detail in this article. The method, involving a fast thermochemical process, as opposed to the slower mechanical means, is called fusion-piercing. The application is being tested on extremely hard low-grade iron ores, known in Minnesota as taconites, which heretofore have defied the economical use of mechanical drilling.



FUSION-PIERCING TESTS were made with this experimental rig at the Reserve Mining Co. property, Babbitt, Minn. An intense flame from a multiple-port burner at the bottom of a 30-ft. revolving blowpipe spalls or melts rock in the hole. As piercing proceeds, the blowpipe is lowered by a winch on the truck.

INITIAL EXPERIMENTS by The Linde Air Products Co. with its new method of fusion-piercing in putting down many 6-in. vertical blast holes, through hard taconite, to a total at this writing of approximately 450 ft. of hole, demonstrate the technical feasibility of this new development. Trial piercing has been in progress during the past three months on the property of the Reserve Mining Co. at Babbitt, Minn., situated near the eastern end of the Mesabi Range.

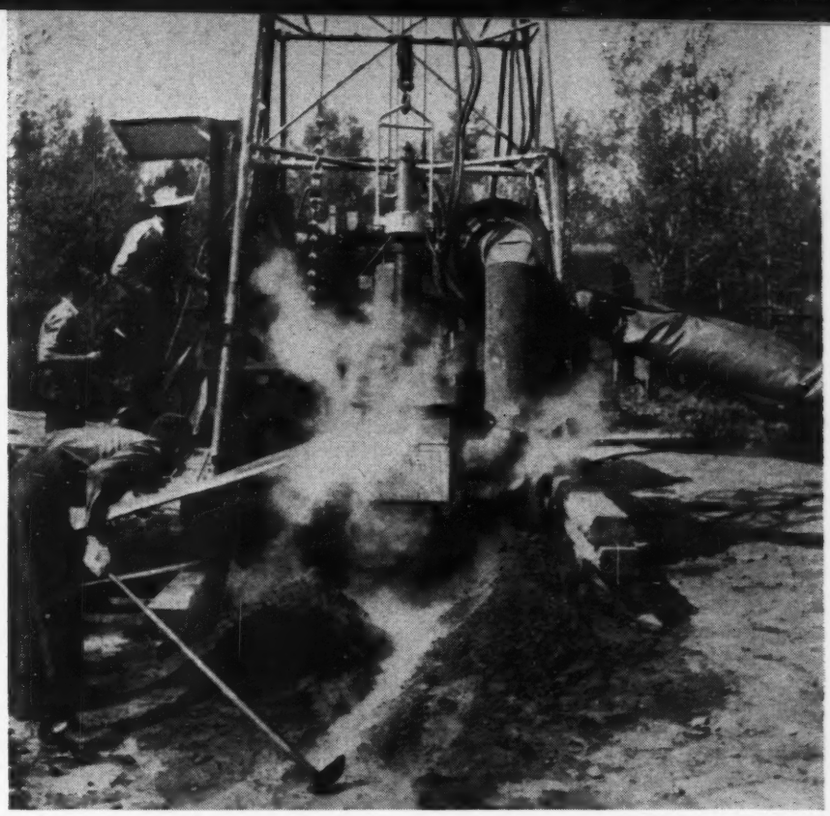
A taconite in the Minnesota parlance is any grade of extremely hard, lean iron ore that has its iron either in banded or well-disseminated structure and which may consist of magnetite or hematite or a combination of magnetite and hematite within the same orebody.

The taconite at the Reserve mining property is extremely hard, consisting of thin to medium bands of magnetites, slates, and cherts interspersed with magnetite. Other constituents are quartzite, pyroxene, and amphibole minerals, and ferruginous and aluminous cherts. Churn drilling during mining in the early twenties penetrated the ore at an average rate of approximately one foot per hour. In contrast, fusion-piercing has penetrated the rock at an average rate of about 10 ft. per hour, the variations ranging from a few feet per hour to as high as 17 ft. per hour for short periods.

Thus, the selection of this area for initial tests is doubly important because the effectiveness of the equipment is demonstrated in the hardest of rocks, and the experimental results obtained definitely point the way toward the economic exploitation of certain taconites in the future. At the Reserve property alone, the deposit is approximately 10 miles long, varying from a few feet in thickness on the north side to in excess of 150 ft. at the south. Overburden is completely lacking in many areas, but averages about 8 ft. Recoverable magnetite in the ore will yield about 22 to 27 percent metallic iron. Approximately three tons of ore will have to be mined to produce one ton of concentrates.

Principle of Operation

In brief, the process consists of directing a flame from a rotating blowpipe against a rock surface. The fact that the holes had to be produced vertically downward has been one of the major problems in the development of a flame method for making blast holes in this material. The flame is produced by the combustion of oxygen and a flux bearing petroleum-base fuel which emerge from separate ports in a



DURING NORMAL PIERCING, one man operates the equipment from a control panel, and another removes slag or spalled material from the collar of the hole from time to time. The fan blows exhaust gases and steam away from the rig. A vertical metal pipe now replaces the collapsible tubing shown.

multiple-port burner. Maximum flame temperatures are about 4,000 deg. F.

The applied intense flame produces spalling and/or melting, depending on the nature of the rock. For instance, a chert spalls readily, whereas magnetite tends to melt with the assistance of the flux in the fuel. In either event, the high velocity of the flame and combustion gases will blast these materials away from the hole bottom and up past a rotating water spray above the burner tip. This rapid quench embrittles both the molten and spalled material and reduces them to fine cinders or chips, which are carried out of the hole by the exhaust gases and the steam which is generated by the contact of the water spray with the high-temperature particles and gases. Approximately 50 percent of the discharged particles are less than $\frac{1}{16}$ in. in diameter. However, flakes with single dimensions reaching one inch are discharged with ease. The continual exposure of the new rock surface to the flame aids the rapid advance of the fusion-piercing process.

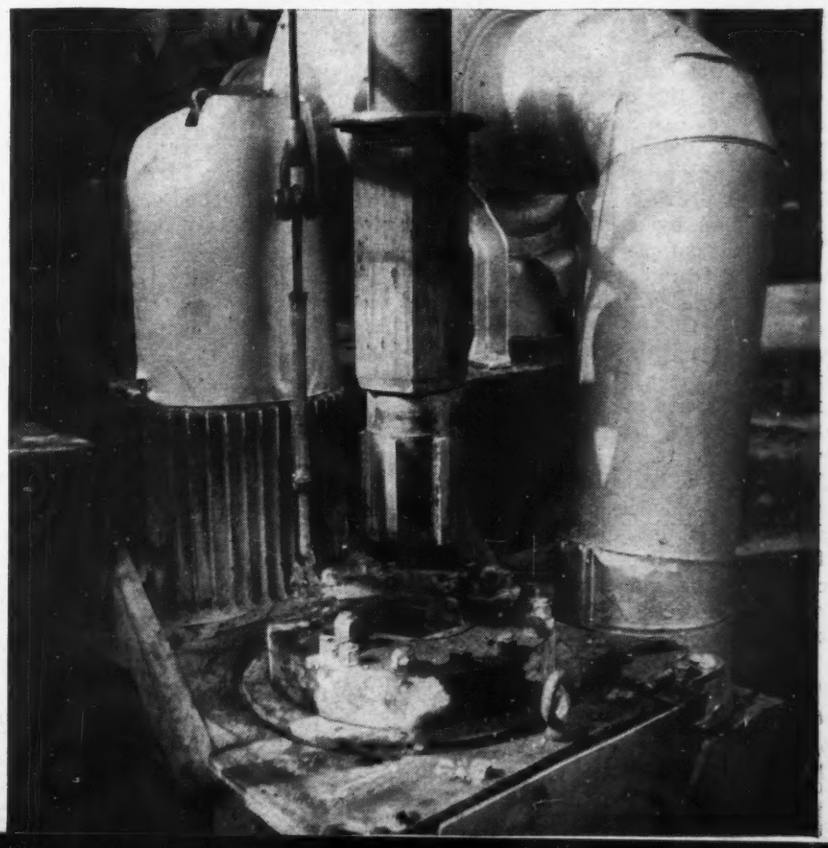
Laboratory tests have indicated that magnetite melts at approximately 2,790 deg. F. and silica at 3,090 deg. F. Taconites melt normally at 2,190 to 2,880 deg. F., but with various fluxing agents this range can be reduced to 1,800 to 2,280 deg. F.

Spalling in cherts is due largely to the conversion of alpha quartz to beta quartz at 1,100 deg. F., at which temperature there is a great expansion in volume. As only the surface of the rock exposed to the flame expands, it breaks loose in thin chips with considerable force from the cooler underlying rock.

Another phenomena observed in connection with fusion-piercing is that cracks extending radially from the hole are developed as the result of thermal stresses produced in the orebody by the flame.

The Equipment. The field development equipment, resembling a portable oil-well drill rig, is mounted on a truck. A standard steel mast of tubular construction was extended to 46 ft. to accommodate the 30-ft. blowpipe used. This was done by inserting a 66-in. section in the mast. The mast is raised rapidly by two hydraulic pistons which are operated by a pump driven by a power take-off on the truck.

The blowpipe, which replaces the kelly in the drill rig, is suspended from the headsheave by a steel cable attached to a single-drum winch. Raising and lowering during piercing is controlled by electric motors. A slow-speed motor gives the operator sensitive control over raising and lowering during piercing, and a relatively high-speed motor permits raising the blowpipe out of



THE BLOWPIPE IS ROTATED by a turntable containing a hexagonal opening which engages a hexagonal sliding collar on the blowpipe. Note the hard-faced blades on the shell near the bottom of the blowpipe, which size the hole and break up large particles of slag or spalled material.

the hole rapidly for inspection or when the hole is finished.

Air-operated stabilizers mounted in the tubular frame and faced with lignum vitae bearing-surfaces may be clamped about the stem of the blowpipe at will, to prevent whip and vibration during rotation.

Rotary motion is imparted to the blowpipe by a gear-reduction motor which is connected to a chain-drive, constant-speed, rotary table. A hexagonal collar-like adaptor fits around the blowpipe stem, and in turn is inserted into the hexagonal opening in the rotary table. See illustration. Three longitudinal flutes on the surface of the stem and inside the adaptor permit these two units to mesh during rotation and still allow free vertical motion of the blowpipe.

The experimental 30-ft., 4½-in. (outside diameter) blowpipe carries water, oxygen, and flux-fuel through separate channels from the head of the blowpipe to the multiple-port burner at the lower end.

Reaming Is Unnecessary

A shell, approximately 8 in. long, having blades faced with hard-facing material, is mounted just above the burner tip and the water ports to break loose any slag which might accumulate on the sides of the hole. Actually, the work done by this device consists of grinding the large particles and sizing the hole rather than reaming. Because this hole sizer-grinder works in the slag-coated sides of the hole, a shell lasts for a considerable time without losing gage materially. The teeth are restored readily by building up with Stellite hard-facing rod.

To make the experimental unit entirely self-contained, a power plant mounted on the truck platform is provided, consisting of a 15-kw. 110/220-v. 60-cycle generator driven by a gasoline engine. This plant supplies power for the nine electric motors which operate the turntable, various auxiliary devices, and the winch. The entire equipment consumed only a fraction of the generator's rated power output during piercing operations.

An exhaust fan draws off the steam and gases which emerge from the hole and discharges them away from the rig. Slag particles do not follow the gases through the fan, but are deposited about the collar of the hole to be removed with a hoe by the helper from time to time.

Operation of the equipment is controlled from an instrument panel conveniently mounted near the back of the rig. Here the operator can control the feed of the various materials to the blowpipe, and change the speed of the winch and reverse its direction. A tensiometer is mounted at one side of the panel which registers the tension in the cable. An engineer's tape is also mounted to a spring reel at one side of the panel to show the depth of the tip of the blowpipe at all times. In fact, the operator keeps his fingers on the pulse of operation continuously from his position beside the panel, and can make all neccessary adjustments by merely flicking a switch, throwing a lever, or twisting a valve.

Compressed air to operate various auxiliary devices is supplied by a rotary air compressor driven from the fan belt of the motor on the truck platform.

Water. The purpose of water in the process is to keep the burner tip cool, to quench and disintegrate the molten and spalled material, and to produce steam which helps carry the particles out of the hole. The water is supplied from any convenient source by a centrifugal pump. Piercing operations in these tests were conducted with consumptions of 100 to 400 gph.

Oxygen. This combines with the flux-fuel just outside the burner tip and produces a high-temperature flame by combustion. For these experiments the oxygen was supplied from a manifold. A control valve regulates the passage of the oxygen to the blowpipe. The supply and distribution of oxygen for piercing operations is a very important phase of this work and one which is currently receiving detailed study by Linde engineers. It may be mentioned, however, that immense volumes of oxygen are being supplied to steel plants and shipyards by Linde methods of distribution, so that a practicable solution to this problem may be expected.

Flux-fuel. The flux and fuel are agitated in a premix tank and pumped to a final mix tank. Here the flux-fuel is further agitated and pumped to the blowpipe. A gage on the control panel registers the pressure. The combustion of this petroleum-base fuel produces huge quantities of gases which help force the slag out of the vertical holes and prevent this material from smothering the flame.

The engineers operating the fusion-piercing equipment state that the process is not at all complicated and that a reasonably capable worker can become a proficient operator within a short time. Following are a few operating practices:

When collaring the hole the blowpipe is lowered to about 5 in. above the rock surface. Rotation is started and the operator turns on the water, oxygen, and flux-fuel feed valves. The combined jets of oxygen and flux-fuel are ignited by passing a lighted oily rag across the burner tip.

As the present tip is designed to produce a flame of maximum effectiveness 4 to 6 in. from the tip, it is important to keep the tip that far from the face at all times.

It was sometimes found desirable, when starting a hole, to use a short hinged hot-top or collar of fire-resistant material. This device is clamped loosely around the flame area and effectively directs the flame at the rock when occasion indicates the need for its use. Once the hole has been started this hot-top is removed easily without interfering with piercing.

Operating Technique

As piercing proceeds below the ground level, the operator watches the various gages on the control panel to see that water, oxygen, and flux-fuel are being supplied in the required amounts. If, during the operation, a cherty band is encountered, rapid spalling will take place, and the distance between the tip and the rock face will tend to increase, and produce a certain amount of chambering. This will cause the gases to emit a characteristic sound which will warn the operator of changing conditions. At the same time an increased tension in the cable line will be observed because the grinder will not be encountering as much slag, and the gases below the burner tip will exert less pressure or buoyant effect upon the blowpipe. The operator speeds up the winch slightly to advance the tip as fast as spalling takes place. If a hard band of magnetite is met, piercing will slow up slightly because the material will have to be melted rather than spalled. The operator is warned of this because the burner tip emits a different sound which indicates closer proximity of the tip to the face. At the same time he will notice less tension in the cable be-

OPERATOR ignites blowpipe with lighted oily rag.

BLOWPIPE emerging from hole, just before burner reaches collar.

cause the grinder will probably be encountering more slag, and the gases below the tip will exert more buoyancy on the blowpipe. The operator then raises the blowpipe slightly with the slow-speed motor to improve burning conditions.

It is desirable to advance the hole by spalling whenever possible, because of the lower fuel consumption and the greater penetrating speed.

In one area the blowpipe was ignited and lowered into a hole containing 15 ft. of water. This head of water did not hinder operations, because the pressure of the oxygen and flux-fuel were maintained high enough to prevent back pressures from extinguishing the flame. The tip was lowered to the bottom of the hole through the water and proceeded to pierce normally, and the water was soon expelled by steam and gas pressures which developed.

Design. It should be clearly understood that although gratifying results have been achieved thus far, this equipment is purely experimental. Research is continuing with fluxing agents, fuels, burner-tip designs as well as varied piercing techniques. It should also be emphasized that this laboratory equipment is far more complicated than that which will be used in regular work. It is still too early to assess the best operating efficiency of the equipment or to predict precise performance.

It can be said definitely that the equipment can be run by two men, an operator at the control panel and a helper. Under ideal piercing conditions, neither of these men will be pushed excessively.

Several desirable features are not incorporated in the design because certain equipment items were unavailable when the rig was built, as for example crawler treads and hydraulic jacks.

Advantages Anticipated

Several outstanding advantages are anticipated by mining men who have witnessed the performance of fusion-piercing in the Mesabi taconites. Of greatest importance is speed in making vertical blast holes, because thus only can the large-scale operations necessary for the profitable mining of taconites be effected. At the same time better fragmentation during primary blasting is also expected because the stresses set up around the hole by the high flame temperatures produce incipient as well as visible cracks radiating from the hole into the orebody. This combination of high-speed piercing and better fragmentation will inevitably lead to lower costs for ore delivered to the crusher.

Another advantage developed through fusion-piercing of this banded structure is the tendency of holes to spall to larger diameters, approaching 12 in. or more in a 6-in. hole, if the blowpipe is not advanced as rapidly as possible through cherty layers. Mining men point out that this corrugating action will permit the placing of split charges or other effective distribution of explosives which has been impossible heretofore in the comparatively uniform holes drilled in taconites by previous methods. Considerable savings in explosive costs are expected.

Mining costs may be further reduced because there are practically no major wearing parts on the fusion-piercing equipment, whereas machine shops, sharpening equipment, and considerable labor were required for drilling equipment formerly used. Drill bits used in 1924 on the taconite deposit now being developed by the Reserve Mining Co. had to be resharpened after drilling 6 in. to 2 ft. of hole.

As excessive physical exertion is unnecessary during normal piercing operations, some observers have concluded that the present two-man rig might be run readily by a man and a half—i.e., two rigs run by two operators and one helper.

Granites, slates, magnetites, and several varieties of silicates have been successfully pierced on the Reserve mining property. Consequently the application of fusion-piercing to other rocks is a likely possibility, particularly because the flux can be varied to suit the deposit encountered.

To support these expectations, it might be added that E. W. Davis, Director of the Mines Experiment Station, University of Minnesota, stated during discussion of his paper "Iron Ore Reserves on the Mesabi Range," at the Oct. 1946 convention of the Association of Iron and Steel Engineers, that he believed he had seen the answer to the problem of drilling taconites more cheaply in fusion-piercing.

E.&M.J. wishes to thank The Linde Air Products Co., 30 E. 42d St., New York City, for making it possible to observe the operation of fusion-piercing equipment in the field. Our thanks are likewise expressed to R. C. Allen, president of the Reserve Mining Co.; F. Emanuelson, in charge of operations at Babbitt; and W. J. McIntyre, mining engineer, for all courtesies.

The Jap at Philippine Mines

NESTORIO N. LIM,
Mining Engineer, Manila

AS SOON AS the Japanese Army occupied the Philippines, warehouses and big stores were garrisoned irrespective of ownership; then the mines were taken over. All companies had figured on shipping difficulties after 1941, and each had ordered from the United States supplies enough to last two years or more. The big mines like Benguet, Balatoc, San Mauricio, United Paracale, Masbate Consolidated, and Mindanao Mother Lode had stocks valued at more than 2,000,000 pesos. Some of these supplies were looted by the natives, but at least 90 percent was taken by the Japanese. In the less accessible mines, which were occupied much later, the percentage of looting by the natives was much higher.

As early as May 1942 some mines were taken over by Japanese companies. Most of the Luzon mines soon fell into their hands and were allocated to various firms. By June 1942 the base-metal mines were in operation and soon shipments of copper, chromite, iron, and manganese ores were moving to Japan.

The Fifth Column

What facilitated these ore movements? Formerly big mining companies in the Philippines had hired Japanese carpenters, the most expensive labor in the mine and second only to American shifters. The minimum pay for one of these men was 5 pesos, compared to 1.50 pesos for a Filipino. They were the most efficient workers. No wonder! They proved to be officers and intelligence men, and they worked fast when the Japanese Army came. They knew the high-grade mines, some having worked in them for more than 20 years. They were even asking about the tin and molybdenum mines that were believed to have been operated by the Americans.

By October 1942 they had formed a Japanese Mining Association of the Philippines. It was headed by Dr. Miki, a mining engineer, but was run by an athletic director. They had more than 25 mining firms in Manila and were sending engineers to the provinces to prospect for copper, nickel, molybdenum, manganese, and chromite. One day in January 1943, more than 50 samples were received by the Bureau of Mines to be analyzed for manganese.

The mining companies operated by the Japanese were: Acoje, Lepanto, Philippine Iron, San Mauricio, San Remigio, Pilar Copper, Mindanao Mother Lode, Toledo Copper, and the manganese mines of Busuanga Island. They explored the Philippine Copper mines in Ilocos Norte, the iron deposit of Bulacan, and the Gold Star iron property, at Sta. Cruz in Marinduque.

Philippine Iron Mines, on Larap Peninsula, were actively operated, and it is said the Japanese shipped to Japan 300,000 tons of iron ore and 10,000 tons of pig iron, the latter being made at the blast furnace of Philippine Smelting Co. in Mambulao, Camarines Norte.

Although the Lepanto mill and mine had been severely damaged before the Americans abandoned it, the Japanese were shipping ore averaging 8.6 percent copper by June 1942. Later they produced 44,362 tons of concentrate. This assayed 24.3 percent Cu and 0.65 oz. Au.

San Remigio's copper mine at Antique and two adjoining properties were explored by the Japanese. About 20,000 tons of 5 percent copper ore was shipped to Japan from San Remigio. Ore in the Antique Consolidated and the Real Copper mines was too low in grade to be shipped.

Pilar Copper's mines and adjoining properties were explored by the Japanese for 1½ years. Except for a narrow vein on the Loay group, which ran 10 percent, only low-grade ore was developed here, and no shipment was made. Other copper properties which they started to develop were the Sipalay, of Negros Occidental; the Toledo on Cebu; and the Zambales. None of these became producers.

No estimate is available as to tonnage of chromite mined. The Japanese had a large-scale operation at Acoje mine, the only chromite property they worked. According to the management, they shipped to Japan 40,000 tons of ore which had been stockpiled at the pier, and had 10,000 tons at the mine, which had been mined before Dec. 8, 1941. In addition, they mined and shipped ore during their operation.

The Japanese produced manganese in Busuanga, shipped 8,400 tons to Japan, 6,500 tons of which had been stockpiled from different mines before the war. At present 5,500 tons of manganese is in stockpiles at the mines or at the pier, which the Japanese mined but were unable to ship. Most of the ore they mined was from outcrops.

Mine Products Shipped to Japan After Pearl Harbor

	Material	Grade	Tonnage
Lepanto	Copper ore	8.6% Cu	12,115
	Concentrate	24.3% Cu(a)	44,362
San Remigio	Copper ore	5% Cu	20,000
Acoje	Chromite	49% Cu	50,000(b)
			80,000
Philippine Iron	Hematite	60% Fe	300,000
	Pig Iron		10,000
Busuanga Island	Manganese	50% Mn	6,500(b)
			1,900

(a) Contained 0.65 oz. gold. (b) Mined before Dec. 8, 1941.

One Gold Mine in Luzon

San Mauricio mine, in Paracale district, was the only gold mine operated in Luzon by the Japanese. The 550-ton mill was run at about one-third of its capacity for two years. The Japanese production was 129,600 tons.

Mindanao Mother Lode was another property operated by the Japs for a short while. Here pumping was a great problem to them, and they were never able to unwater the mine. The mill ran on tailings which had been impounded for remilling, and when they were treated, the operation stopped. The mine was not worked.

The mining industry in the Philippines was badly damaged during the occupation, in that mine and mill machinery was moved from one mine to another and most of the supplies were looted or taken away. Buildings were taken down and put up again in other camps. A good example was the transfer of those at the Baguio mines to the Lepanto Consolidated. Big machines and diesel engines from Balatoc were installed at Lepanto. All mine and mill supplies were taken to the copper mine. These improvements at Lepanto, however, were destroyed by fire when the Japanese retreated.

At the opening session of the Congress. In the center, left to right, are E. Macedo Soares e Silva, Brazil's Minister of Transportation and Public Works; Campello Netto, Minister of Agriculture and personal representative at the Congress of President Dutra; and Antonio Jose Alves de Souza, President of the Pan American Institute of Mining Engineering and Geology. Continuing to the right are Maria Rodrigues, Roberto Cardoso, and Edward Steidle, vice presidents. At extreme left is P. V. Shaw, official translator.

Pan American Delegates Welcomed at Rio Congress

ROBERT H. RAMSEY
Associate Editor

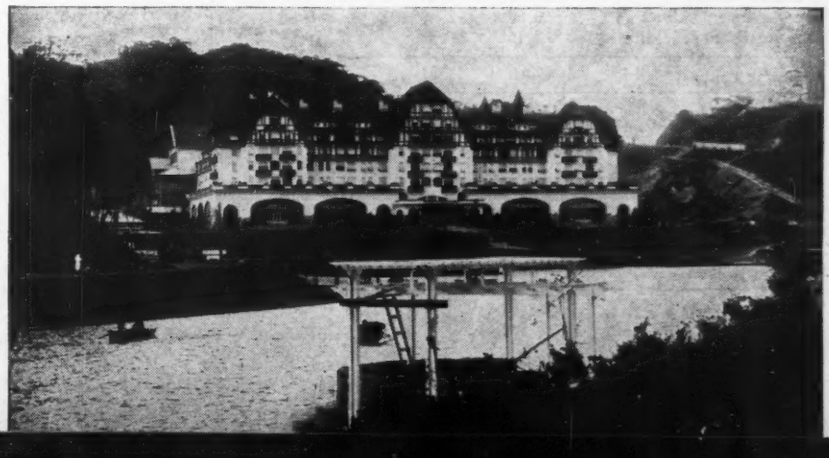
MEETING in the unparalleled luxury of the Government-operated Hotel Quitandinha, high in the hills above Rio de Janeiro, Brazil, the second Pan American Congress of Mining Engineering and Geology opened on Oct. 1. It was attended by more than 200 delegates from 11 American countries. More than 170 technical papers were presented for discussion and possible publication, and opportunity was offered for exchange of views on mining affairs of mutual concern to the countries represented. The first week of the Congress was given over to discussion of papers and resolutions; during the second week, the delegates separated into five groups that were guided on different excursions to regions of geological or mining interest in Brazil. The meeting closed on Oct. 16, and before doing so adopted a resolution calling for the convening of the next Congress within four years and in the United States.

The official delegation of the United States included Charles C. Daniels, counselor of the U. S. Embassy in Brazil; R. R. Sayers, Director of the U. S. Bureau of Mines; Edward Steidle, dean of the mining school of Pennsylvania State College; and W. E. Wrather, Director of the U. S. Geological Survey. Dr. Steidle is also a vice president of the Pan American Institute of Mining Engineering and Geology.

The meeting was conducted, and the several excursions were arranged, by the Brazilian section of the Institute, with the assistance of the Brazilian Government. All events proceeded well, and the extremely difficult job of moving groups of 40 or more people on the excursions through Brazil's mining areas was handled with surprising smoothness. The mining companies visited were most hospitable.

Among the resolutions adopted by the Congress were the following: to continue and increase technical cooperation in geological, mining, and metallurgical research, by exchanging personnel and information; a reaffirmation of the economic charter of the Americas, as declared at Chapultepec; a suggestion for uniformity in preparation of mineral statistics in the Americas; likewise a suggestion for creation of a Pan-American group to study and correlate mining law of the Americas; and another for promoting the exchange of goods.

No papers were actually read at the meeting, the presentation taking rather the form of referring papers to various commissions, which discussed and disposed of them. Papers were then voted upon as to publication or rejection.



SUMPTUOUS QUITANDINHA HOTEL, here seen beside the lake at Petropolis, suburb of Rio de Janeiro, was the setting for the sessions of the second Pan American Congress of Mining Engineering and Geology

Making Tin Flotation Work—

A. M. GAUDIN and FALIH ERGUNALP,* Richards Ore Dressing Laboratory, Massachusetts Institute of Technology, Cambridge, Mass.

In this second of a series of four articles, a combination leaching and flotation process is described for the Oploca tin ore, mined by a subsidiary of the Patino organization. An unusual all-flotation method for Hochschild's Colquiri ore will be described next month.

INVESTIGATION of the Oploca ore was carried out from June 1943 to June 1944 for the Compañia Minera y Agricola de Oploca de Bolivia, whose mine, one of the country's largest producers of tin, is in southern Bolivia. The ore is beneficiated by a compound process of roasting, comminution, and gravity concentration. Purpose of roasting is to disintegrate the pyrite and other sulphides, thus increasing cassiterite liberation and replacing high specific gravity pyrite by lower gravity oxides. According to estimates made by one of us when visiting the plant in 1942, the recovery of tin made was of the order of 50 to 60 percent. A one-ton shipment of ore, received at Cambridge on June 15, 1943, was sampled and found to contain 2.98 percent tin.

Mineralogy

Outstanding mineralogical features were determined from eight polished sections of unground ore, from briquettes of various concentrates and tailings, and from petrographic inspection of unmounted particles.

The ore consists mainly of sulphides, silicates, and cassiterite. Sulphide minerals make up about one-third of the ore by weight. Pyrite is the most abundant sulphide and constitutes not less than one-fifth of the ore. Other sulphides include chalcopyrite, arsenopyrite, pyrrhotite, sphalerite, and stannite. The sulphide tin (stannite) occurs in minor amount, and is found as small specks and veinlets in the pyrite and the silicates.

White mica and quartz constitute the bulk of the silicates. From a flotation viewpoint, the outstanding feature of the silicates is that they contain inclusions and adhesions of sulphides of minute size which render some of the silicates floatable under soap flotation of cassiterite.

About 95 percent of the tin occurs as cassiterite, found in grains of appreciable size as well as in a state of fine dissemination within other minerals, particularly the sulphides. The amount of cassiterite so disseminated is relatively small, but this occurrence of the mineral becomes a major factor when maxi-

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Table I. Typical Test Data—Oploca Ore

Products	Weight, Percent	Tin Assay, Percent	Tin Distribution, Percent
Sulphide reject	30.67	0.81	8.83
Tin rougher tailing	45.50	0.31	5.02
Tin cleaner tailings	13.52	0.96	4.61
Tin re-treatment tailings	6.55	2.40	5.58
Tin re-treatment concentrate	3.76	56.88	75.96
	100.00	(2.81)	100.00

Table II. Separation of Stannite From Pyrite

Products	Weight, Percent	Tin Assay, Percent	Tin Distribution, Percent
Black sulphide float	2.48	3.38	3.40
Pyrite sink	33.53	0.50	6.79
Bulk sulphide float	(36.01)	(0.70)	10.19

Table III. Distribution of Silver in Flotation Products (Test 81)

Products	Weight, Percent	Silver, Oz/Ton	Silver Distribution, Percent	Tin Assay, Percent	Tin Distribution, Percent
Black sulphides	3.63	129.78	74.3	3.32	5.27
Pyrite	30.50	5.38	25.7	0.48	6.40
Cassiterite	3.46	tr.	0.0	48.20	72.87
Siliceous tailings plus middlings	62.41	tr.	0.0	0.57	15.46
	100.00	(6.36)	100.0		

No. II, Oploca Ore

mum recovery of tin is sought.

Sulphides prepared by flotation and then sized by screening contained, in the 200/270-mesh size, 0.54 percent soluble tin and 0.87 percent insoluble tin; minus-270-mesh sulphides contained 0.33 percent soluble tin and 0.64 percent insoluble. It is evident that cassiterite inclusions are widespread in sulphides, even in very fine sizes. Estimates based on microscope study indicate that sulphides 40 microns in size contain cassiterite inclusions of an average size of 22 microns, and that 22-micron sulphides contain cassiterite inclusions averaging 9 microns in size.

Typical Test

A typical experiment was test No. 91, in which three 2,000-gram batches of ore were ground for one hour and a half each in porcelain mills to 96 percent minus-200 mesh and 88 percent minus-270 mesh. The sulphides were floated at the natural pH of 3.7 after a conditioning time of 5 minutes, using the 2,000-gram Denver cell, with potassium ethyl xanthate, 0.10 lb/ton, and pine oil, 0.058 lb/ton. The froth was refloated three times in 1,000-gram Fagergren bowls using a total additional quantity of 0.020 lb/ton ethyl xanthate and 0.033 lb/ton pine oil. This operation is a simple bulk float of no difficulty. The repeated cleaning drops cassiterite and locked particles.

The combined rougher and cleaner tailings from the sulphide floats were dewatered by settling and decantation, then floated for cassiterite in the Denver machine, using the following reagents: sodium hydroxide, 1.5 lb/ton; Calgon,* 0.10 lb/ton; Nujol, 0.24 lb/ton; oleic acid, 0.42 lb/ton; and pine oil, 0.030 lb/ton. During this operation the pH became 7.3. Oleic acid was added in two portions of 0.28 and 0.14 lb/ton, followed by conditioning periods of 5 and 10 minutes respectively. The rougher tin float was cleaned twice in the Fagergren cell, using only pine oil (0.010 lb/ton).

The cassiterite float was now treated with hot, somewhat diluted aqua regia, a total of 70 lb. nitric acid and 60 lb. hydrochloric acid being used per ton of ore. This dissolved certain minute quantities of sulphides, which by their attachment to gangue minerals lowered markedly the grade of the concentrate. The weight dissolved was negligible, and the acid consumption (not ascertained) was clearly but a small fraction of the quantity used. After leaching, the pulp was washed to eliminate dissolved iron, the pH was adjusted to neutrality (6.9), and the cassiterite was refloated with minor quantities of oleic acid and pine oil. Four cleanings were made in this re-treatment. Results are given in Table I.

* This use of Calgon was developed at M.I.T. by Dr. R. Schulmann, Jr., in connection with work on a tin ore described in the next article of this series.

Steps in Suggested Process for Oploca Ore

1. Grind to 95 percent minus-200 mesh in non-metallic mill.
2. Float sulphides with xanthate at natural pH (about 4.0).
3. Float cassiterite at pH about neutral, using oleic acid, a hydrocarbon oil, and Calgon.
4. Regrind cassiterite rougher concentrate.
5. Leach reground product with acid and wash to remove dissolved iron.
6. Float leach residue at pH about neutral with minute quantities of same reagents as step 3.

Stannite Recovery

Stannite floats with pyrite, but may be separated from it by retreatment in a circuit made highly alkaline with lime. Thus, in test No. 87 a separation was made at pH 11.5 by addition of lime, 3.0 lb/ton, KCN, 0.10 lb/ton, and $CuSO_4$, 0.12 lb/ton. The results are shown in Table II. This stannite separation may be warranted by the fact that silver in the ore is largely concentrated in the black sulphide float, as shown in Table III. It is believed that silver occurs either in solution in the stannite, or as sulpho salts that look much like stannite.

Grinding Is Delicate

A marked difference in behavior has been observed as between tests using an iron mill for grinding and those using porcelain mills. For one thing, the ground pulp from an iron mill is less acid, which suggests that iron is dissolved by hydrogen ion. Secondly, more iron (ferrous) is found in solution when an iron mill is used. These phenomena parallel each other and are perhaps to be related to the suppression of oxidizing conditions when the grinding is being done in a closed iron mill.

In short, no acceptable results were obtained with an iron mill grind except by introducing desliming or leaching of the whole ore. In practice, this would be interpreted as meaning that tube mills with a siliceous lining and access of oxygen would have the preference.

The Tin Float

Certain difficulties arising in the cassiterite flotation have been traced to certain soluble salts in the ore, and to the locked particles of sulphides and gangue in which the sulphides are in the minority. The use of a porcelain mill and small amounts of Calgon helped solve the soluble-salt problem. The mechanism by which Calgon operates is not well understood, but it may have to do with the complexing of ferrous iron or of other polyvalent ions by the Calgon and/or the adsorption of the Calgon or the complex on certain mineral surfaces. The action of Calgon seems worth investigating further.

A hydrocarbon oil, such as Nujol,

was found useful, perhaps because it tended to aggregate the floating mineral into clots which were removed from the cell more quickly than individual particles.

The Leach

The leach was not studied in detail, and some hope remains that leaching may be avoided. The basic reason for a leach is to remove minute pyrite specks from the surfaces of some of the silicate particles, and thus inhibit their tendency to float like cassiterite if a fatty acid circuit is used. However, regrinding results in some liberation, and the sulphides can then be floated with xanthates or fatty acids at a pH of 2 or 3. In fact, regrinding followed by an alkaline amine float is also fairly effective in removing the sulphides. But the best re-treatment float has so far been obtained after an oxidizing leach had dissolved the pyritic adhesions. Such an acid leach has the further advantage that considerable ferrous iron, possibly adsorbed at the surface and in the pores of silicate particles, is dissolved. In our experiments the acid leach has been carried out by heating in large beakers on a water bath.

The re-treatment feed (or leach residue) is washed thoroughly to remove dissolved soluble salts. This operation deserves further study, for it is probably one of the sources of difficulty in the proposed process.

Re-treatment Float

The re-treatment float is similar to the tin float in most respects except that the re-treatment feed is much lower in slimy silicates (micas, kaolin) and in soluble salts; accordingly the operation is more satisfactory. In one case a concentrate assaying 69.8 percent tin was obtained; it is clear therefore that there could not be much else than cassiterite in it.

Water

Laboratory work was done with distilled water, as it was thought Cambridge tap water might introduce certain deleterious soluble salts that would differ from those likely to occur in Bolivia. It will therefore be necessary to determine the extent to which soluble salts in the native water can be tolerated, and whether a water-softening plant is necessary.

Profile Technique Useful In Mapping Stope Geology

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A STOPE on an inclined bed or on a vein raises the question as to how best to portray the geologic features. If the ore is regular in dip and strike, the simplest picture may be a projection of the stope outline and geology in the plane of the inclined layer, but if the layer is folded or warped, or is to be used in conjunction with plan maps of levels or surface maps, this scheme is unsatisfactory. The alternative, a projection to a horizontal or vertical plane, is more practical but demands a considerable use of descriptive geometry or trigonometry because most of the measurements have to be made along inclined lines.

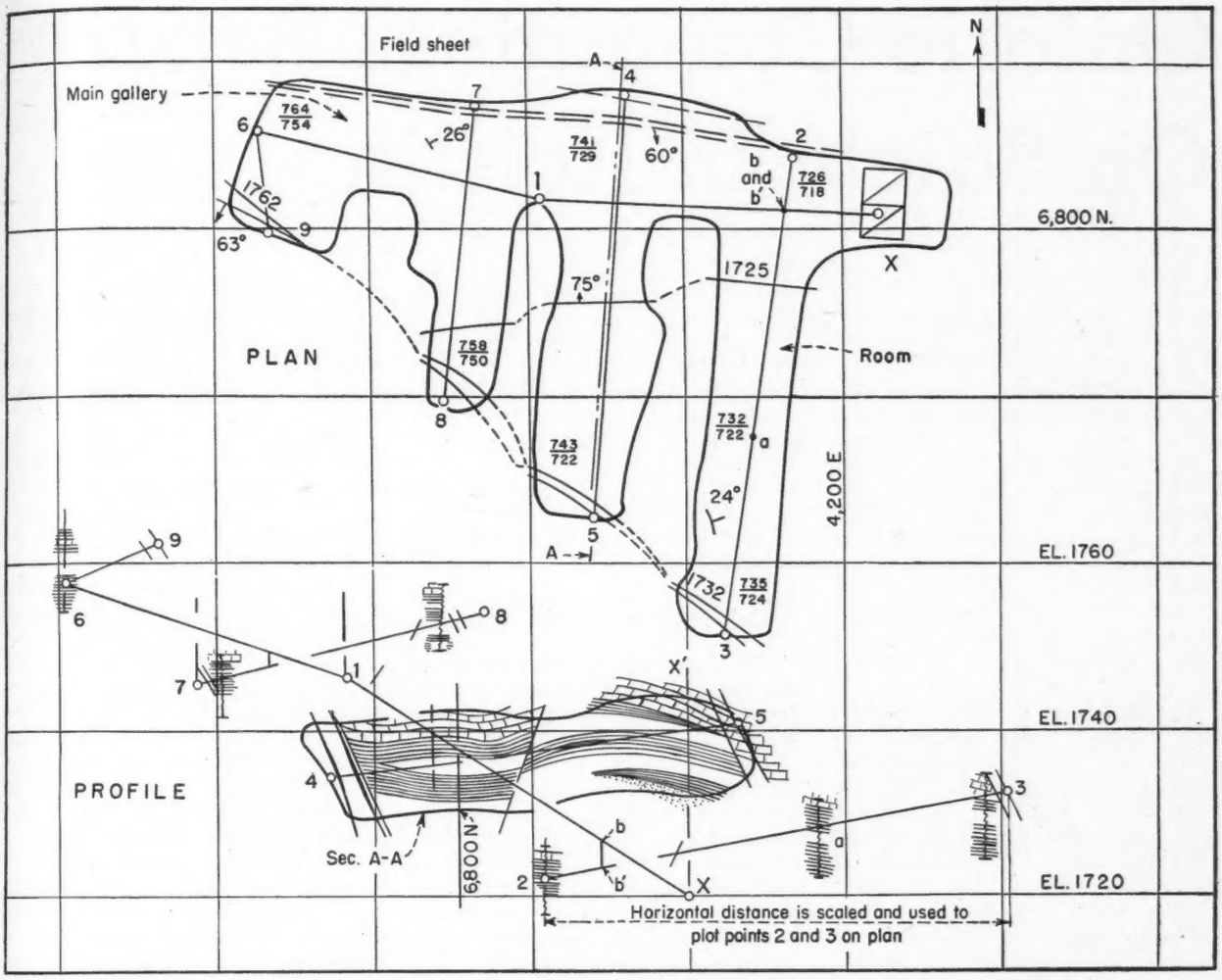
For mapping room-and-pillar stopes in flattish limestone replacement deposits in New Mexico, I have devised a "profile technique" which can be used, with appropriate modifications, in a wide variety of inclined stopes. Plans and sections can be plotted underground without delaying completion of maps pending office computations. Furthermore, the graphic solution of the three-dimensional problem remains on record in systematic form.

The Procedure

The essential steps of the technique are as follows: (1) Measurements in the stope are made with tapes which are stretched between wall points and temporarily fixed in horizontal or inclined positions, depending on circumstances, and (2) the vertical and horizontal distances between the points are ascertained by plotting a profile at the side of the map as the work proceeds. On the profile, which is not to be confused with a vertical section, the measured lines are plotted in their true length and inclination so that each point on the line appears at its proper elevation. See accompanying illustration, which describes the procedure of mapping a stope on a field sheet.

One small disadvantage inherent in any horizontal projection of a set of inclined workings is that strikes of features, such as the fault shown at points 3, 5, 8, and 9 in the accompanying illustration, do not line up, because they are observed at different levels. Despite this disadvantage, however, it is probably best in the original record to plot such features at the points at which they are observed and with their true strikes. In addition, it may be feasible to measure the bearing of the trace of the fault on some geologic surface and plot this on the projection in a dashed line.

I want to thank J. V. Neuman, chief engineer and geologist, Bayard Unit, United States Smelting, Refining & Mining Co., for suggestions and discussion which have aided in the development of mapping techniques suitable to local conditions, and the management of the company for permission to publish this article.



How the Profile Technique Was Used to Map a Stope

1. The distance from X to 1 along the main gallery was measured by stretching a tape between these two points. For survey stations, lead-headed roofing nails were driven into cracks in the rock. The lead head reduces the tendency of the nail to bend, because it cushions the hammer blow.

2. The length and inclination of the line X-1 were plotted in the profile at the bottom of the sheet, and the horizontal distance between X and 1 was scaled from the profile.

3. Using the Brunton bearing of line X-1, the point 1 was plotted in its true position on the plan.

4. Without removing the tape, a second tape was stretched from point 2 to point 3 in the first room. The second tape passed below the first tape at point *b* (shown on the second tape as *b'*).

5. The vertical distance between the two tapes was measured, and the line 2-3 was plotted on the profile after point *b'* had been located.

6. After scaling the horizontal distance 2-3 on the profile and using the measured bearing of line 2-3, the points 2 and 3 were plotted on the plan.

7. It should be noted that line 2-3 could have been plotted from right to left, or from left to right; which direction is followed is not significant except with respect to the particular lines on which they appear. However, consistency increases the clarity of the notes. Here, for example, measurements in the gallery X-1 and 1-6 are plotted from right to left, whereas measurements in the room 2-3, 4-5, and 7-8 are plotted from left to right.

8. Intermediate points of geologic interest along the lines 2-3 were plotted on the profile and then transferred to the plan. Thus at *a* on the profile, there appears a geologic column from roof to floor and the elevations at the roof and floor are shown in their correct vertical positions. These elevations, scaled from the profile, have been recorded numerically on the plan as 732 and 722, respectively, at point *a*.

9. After all data for the first room 2-3 had been recorded, the tape was removed to the second room and the points 4 and 5 were established in a similar manner. At the same time vertical geological sections such as the one through room 4-5 were prepared.

Ontario Committees Report On Safety in Hoisting

LOSS OF 16 LIVES in a fall of the cage in No. 5 shaft of Paymaster Consolidated Mines, Ltd., South Porcupine, Ont., on Feb. 2, 1945, led to the immediate creation of two committees to investigate the causes of the accident and to recommend improvements in hoisting practice.

A non-industry committee was appointed by the Minister of Mines of the Province, consisting of C. R. Young, Dean of the Faculty of Applied Science and Engineering, University of Toronto, chairman, and Professors T. R. Loudon, E. A. Allcut, V. G. Smith, and L. M. Pidgeon, all of the University faculty. The 36-page report of this committee has recently been published, together with the conclusions and recommendations accompanying the preliminary report of an industry committee appointed by the Ontario Mining Association and consisting of R. E. Dye, general manager, Dome Mines, Ltd.; R. D. Parker, general superintendent, International Nickel Company of Canada, Ltd.; and R. L. Healy, general manager, Wright-Hargreaves Mines, Ltd. The results of the far-reaching investigations of these committees are summarized herewith.

What Caused the Disaster

The primary cause of failure of the Paymaster hoisting rope was determined to be internal corrosion, not observable from external examination of the rope. The secondary cause was failure of the safety dogs to hold the descending cage.

The rope in use at the time of the accident was nominally 1 in. in diameter and of flattened strand, lang-lay construction, containing six strands of 27 wires each. In the region of the break, the internal wires were in a disastrous state of corrosion, which had taken place in the interstices between strands and inside the strands themselves.

Rotation of the four safety dogs was limited by shelf angles attached to the drawbar about 3½ in. above the top of the cage. Evidence showed that the safety dogs took hold at approximately 57 ft. below the 900-ft. level, gouged out one guide for about 20 in. and the other for about 36 in., disengaged, and then partly reengaged. The inability of the dogs finally to bring the cage to rest was attributed in part to clogging of the space between the shallow teeth with wood shavings, with resultant skidding, and in part to a probable faulty setting of the linkage or fouling of the drawbar stops.

Exhaustive Study Made

The committee's investigation of the accident itself was preliminary to an exhaustive examination into all phases of hoisting practice.

Freedom from excessive whipping and moderate rope wear are promoted by the use of hoist drums large enough to avoid more than two layers of rope with the cage at surface. Bending stresses are kept down to a negligible value when the ratio of drum diameter to rope diameter is as high as 120. The committee's recommendations are for a ratio of between 80 and 100.

The effect of large head sheaves is to reduce bending stresses and to offset the destranding tendency, which, for a given arc of contact, is greater for small than for large sheaves. The diameter ratio of sheave to rope should therefore be brought up to 80 or 100, depending on rope structure. Sheaves should be designed with a relatively low rotational inertia to lessen the effect of a trailing rope in case of accident.

High ultimate tensile strength does not ordinarily carry with it a high fatigue limit under working conditions. More emphasis should be placed on securing ropes of improved fatigue and corrosion-resisting properties. The need for a program of systematic research in the field of desirable properties for rope wire is emphasized.

Rope types should be simple and rugged. Nicking and wear increase as the build-up of strands becomes more complex. Evidence indicates that no greater flexibility is necessary than that provided by a rope of 6 strand, 19 wire construction, unless the sheave diameter is less than 19 rope diameters. Use of many small wires provides a large surface area for attack by corrosion.

The wide contacts between strands of a flat-strand rope render it vulnerable to corrosion. Therefore round-strand ropes are recommended for wet shafts. Lang-lay is preferable to regular lay rope in that it provides higher endurance when bent over sheaves or drums, this notwithstanding the distinctive flexibility of regular lay ropes.

The factor of safety for hoisting ropes, as usually interpreted, is the ratio of the test strength of the rope at purchase to the maximum load suspended, plus the weight of the cable from the head sheave to the cage. The U. S. Bureau of Mines specifies a minimum factor of 4 for lengths of rope 3,000 ft. or greater, progressively increasing to 8 for ropes of 500 ft. length or less. Ontario regulations prescribe a minimum factor of 6 for shafts less than 2,000 ft. deep; 5 for shafts 2,000 to 3,000 ft. deep; for over 3,000 ft. no rope may be used for raising or lowering of men with a factor below 4.5. The choice of factor of safety should take into account that the bending stress on the wire, usually greater than the direct tensile stress due to the load, is neglected. Thus the combination of the computed tensile stress and the estimated bending stress should not exceed the fatigue limit of the wire.

Ideal for Corrosion

Conditions under which wire ropes operate are ideal for corrosion. Evidence exists that a deteriorating wire under reversed stress may corrode 200 times as rapidly as the same wire at rest. Corrosion may take place between strands, as in the Paymaster case, with the result that rope strength may fall to one-third of the original without external evidence. Nicking or wear of the wire surfaces inside the rope facilitates corrosion and, in its train, corrosion-fatigue, producing deterioration far more se-

vere than either influence acting separately. So far the only practical means of retarding corrosion appears to be the addition of "dressing" to the rope. The provision of protection by means of metal coatings, either noble or base, should be studied. The paramount influence of corrosion on deterioration dictates thorough research.

External wear of hoisting ropes results from rubbing against the drum and sheave as well as against neighboring turns of the rope on the drum and obstructions in the hoist house or shaft. Discarding of the rope is recommended when abrasive wear on outside wires at any section exceeds 20 percent of their area.

Internal wear, unaccompanied by corrosion, is seldom the cause of rope breakage. Plastic wear, in which there is deformation but no loss of material, is created by intense bearing pressures between the wire and the drum, sheave, or any fixed object. Cold-working has reduced the capacity of the wire to undergo further cold deformation. Marked indications of plastic wear were found in the broken Paymaster cable.

Accurate measurement of rope diameter by rope calipers at about 150-ft. intervals, staggered from month to month, is a useful procedure. Periodic measurements of the stretch should also be made and its rate carefully studied.

Daily Inspection Advised

Daily visual inspection of hoisting ropes, not a present practice at many mines, is strongly recommended as essential to the immediate detection of such obvious defects as broken wires.

Since the principal source of rope deterioration — loss of section through corrosion and wear — involves increased stress for a given suspended load, many efforts have been directed toward correlating magnetic variations with metal loss by using induced magnetic flux to produce electrical excitation of a specimen, and by using a search coil to detect variations in the magnetic reluctance caused by the deterioration.

Apparatus consisting of a 25-cycle detector applied to an endless ¼-in. cable by the International Nickel Company of Canada, in its laboratory, was successful in indicating the presence and to some extent the degree of deterioration, but was not capable of differentiating between the various types.

Extensive research was done by the General Engineering Co. (Canada), Ltd., using a Du Mont cyclograph on ropes of ¼-in., ⅝-in., ¾-in., 1¼-in., and 1½-in. diameters having artificial defects of corrosion, abrasion, kinking, severe crushing, and broken wires. Corrosion with acid, reducing the rope strength by 5 percent, was clearly indicated, but the filing of 18 outside wires to half thickness gave no observable indication. Kinks were not indicated, and severe crushing was indicated only when the rope was stressed almost to failure. Broken wires were clearly indicated until the sample was vibrated. The frequency used in these tests was 7,900 cycles per second, raising some question as to the penetration of the flux into the rope.

Not Infallible

Sufficient promise exists in the results of investigations to justify the continuation and extension of these tests, using low-frequency as well as high-frequency devices, but the possibility is emphasized that a serious mechanical defect might give no magnetic indication whatever, and magnetic inspection must not be regarded as a substitute for present methods of inspection.

It is erroneous to consider the strength of a rope as the sum of the strength of the individual wires that appear to be intact, less an allowance for spinning. Fractures in visible wires are the result of deterioration which is likely to have been communicated to those which are not visible. Ontario regulations, which allow a tolerance of six broken wires in one lay for a rope used in raising or lowering men, are considered too lenient.

The Worst Section

As illustrated in the Paymaster accident, where badly corroded sections of rope existed some 1,100 ft. above the capel, the worst section of a rope will in many instances not be at or near the capel, within the length likely to be cut off for routine testing. However, if these tests show corrosion, the possible existence of worse sections elsewhere should be suggested.

With regard to lubrication, it is noted that the primary function of rope lubricant is the prevention of corrosion. Rope-dressing practice exhibits no standardization. This situation would be improved by a research program carried out jointly by the mines, the manufacturers of rope dressings, and the manufacturers of rope, to determine what is the best type of dressing for a company to use.

The history of hoisting accidents does not support the opinion that a general reduction of hoisting speed would promote safety of hoisting operations. Control of overspeed

(*Continued on page* 99)

Recommendations for Improved Hoisting Safety

1. Use of drums and head sheaves of diameters not less than 80 to 100 times rope diameter.

2. A program of systematic research in the field of desirable properties for rope wire to be incorporated into a standard specification.

3. Thorough investigation of means of corrosion prevention in mine hoisting ropes, including a study of types of rope dressing.

4. Encouragement of research into electromagnetic methods of hoisting-rope examination.

5. Investigation of the feasibility of incorporating electrical conductors in hoisting ropes for purposes of cage-to-surface communication and to provide automatic brake application in case of rope failure.

6. Development of improved safety devices to operate effectively against the influence of a trailing rope.

7. Appointment of competent professional engineers with mechanical experience to supervise Department of Mines inspections of hoisting equipment and recommend mechanical improvements.

8. Cooperative restudy of hoisting regulations by the Department of Mines and the mining industry.

Cornwall as a Tin Producer —Today and Tomorrow

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Two mines remain in operation, the once-famous district having come to this condition fundamentally because of the high cost of deep mining, and in part because of the lack of skilled labor. There is still tin in the ground, and some day, when alluvial mining wanes, the world may see production stepped up in this ancient region.

TIN HAS BEEN the principal economic mineral occurring in Cornwall. The geology of the country is such that the zone nearest the surface generally contains lead-zinc ores, below which is copper ore, then a tungsten-tin zone, and, finally, in the deepest zone, tin ore. Although this sequence predominates, there are many places where tin has been worked near the surface. On the other hand, fifty years or so ago the world's deepest tin mine was being worked at Dolcoath, in the Duchy, more than 3,000 ft. deep.

The tin veins occur in fissures in granite. The ore hoisted to surface is milled and the tin concentrates, running about 65 percent tin, are separated as a black powder. The ratio of concentration is 60-100 to 1.

From 1850 until about 1895 a large number of mines were operating in Cornwall and some rich lodes were worked. In 1865 Cornwall produced 41 percent of the world's tin. In 1875 this proportion had fallen to 23 percent, in 1913 to 4 percent, and in 1939 to only 1 percent. Although this change was due to some extent to depletion in Cornwall, it was caused chiefly by the rapid development of large-scale tin production in other parts of the world, as shown in Table I.

Even when supplies of tin from the Far East were cut off, during the Japanese occupation, there was no significant increase in Cornish production, which amounted to only 2 percent of the available output in 1943. (See Table II).

The richest lodes naturally yield the greatest profit, and are worked out first. Poorer ground is then worked, but there comes a time when it is no longer profitable to operate, and unless the mining company has sufficient resources to sink new shafts and discover new lodes, the mine has to close. Even when a mine is operating on a good lode, a fall in the price of tin may render operation uneconomic, in which case mining is stopped but the pumps are kept running. After a long period of low prices it may not be possible to continue pumping.

All these factors have operated in Cornwall. The average output in the latter half of the last century was 8,240 tons of metallic tin per year. Exhaustion of the richest lodes caused a drop to 4,510 tons per year from 1901 to 1920. More recently, not only have there been fewer rich lodes in operation, but many mines have been abandoned during periods of low prices. In 1941 only three Cornish mines remained in operation and today only two of these are working. The 20-year average for 1921-1940 was 1,835 tons per year. (See Table III).

In the period 1918-20 the average price of tin was £294 per ton, but this was followed by the great post-

Table I. Changes in World Production of Tin

(Metal content of ores mined, in tons of 2,240 lb.)

	1865	1875	1913	1939
Cornwall	10,039	9,614	5,288	1,633
Malaya	6,000	8,566	51,377	56,001
Dutch E. Indies	5,281	7,791	20,921	31,410
Siam	2,000	2,500	6,748	16,970
China	500	1,500	8,257	10,859
Australia	130	11,089	7,780	3,500
Bolivia	100	300	25,939	27,215
Nigeria	Nil	Nil	3,872	10,855
Belgian Congo	Nil	Nil	6	9,663
Other countries	150	240	3,612	15,364
Totals	24,200	41,600	133,800	183,500

Table II. World Tin Production in 1943

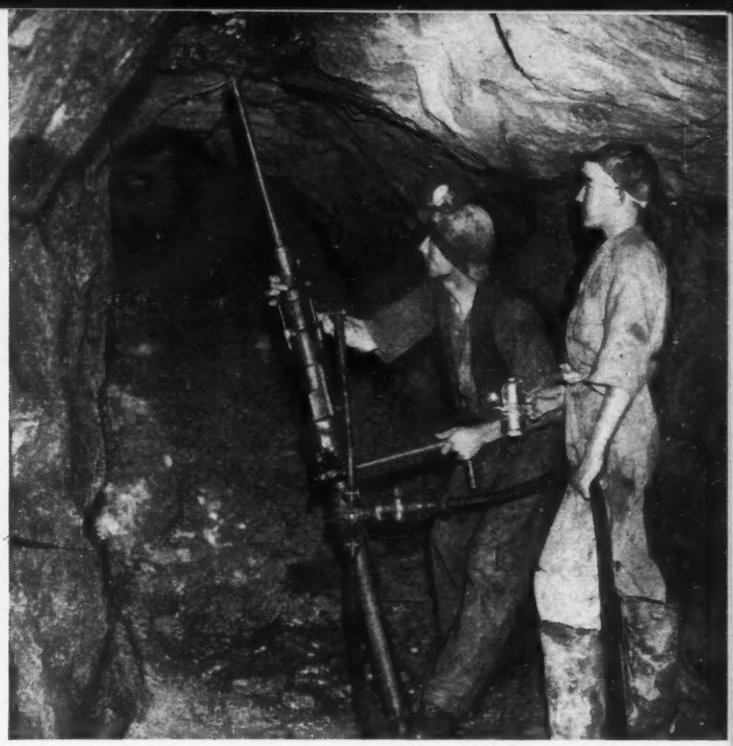
	Tons	Percent
Cornwall	1,750	2
Bolivia	41,523	46.5
Nigeria	12,670	14
Belgian Congo	16,833	19
Australia	3,500	4
China (*a*)	4,300	5
Other countries	8,424	9.5
Total	89,000	100

(*a*) Not including Japanese occupied territory.

Table III. Tin Production in Cornwall 1801-1940

Period	Tons	Tons per Year
1801–1850	213,000	4,260
1851–1900	412,000	8,240
1901–1920	90,200	4,510
1921–1940	36,700	1,835

LOADING A CAR at a chute in a Cornish tin mine. Today, only two of the properties that formerly operated are running.



Photos by Graphic Photo Union, London

A DRILLER starts to collar an upper hole.

war slump of 1921-22, during which the price averaged only £162 per ton and the output of tin in Cornwall fell from about 3,000 tons in 1920 to only 370 tons in 1922. In the period 1925-27 tin prices averaged £280 per ton and stimulated fresh investment in the Cornish industry, which led to an output of 3,271 tons in 1929. Another slump in 1931, when the price averaged £118 per ton, caused output in that year to fall to 598 tons. A number of mines suspended production, some of which have never reopened. These facts and figures clearly indicate that in the past 20 years Cornwall has been on the margin of economic production, but they also indicate that, given an adequate, stable price for tin, the industry can recover.

Recent Developments

When the Japanese overran the Far Eastern tin fields early in 1942, the Ministry of Supply assumed control of the nation's tin supplies. It was advised by local engineers that the best policy would be to concentrate all energy on reopening mines in Cornwall that had closed owing to the low price of tin. The ministry considered that an immediate increase in output was essential. Accordingly, numerous dumps and old alluvial workings were examined, but little was achieved.

The three mines in production at that time were South Crofty, East Pool, and Geevor. A working arrangement was made with the companies whereby the ministry purchased the whole of the output on a "cost-plus-percentage" basis, but unfortunately the rate of profit permitted was based on that earned in the years immediately prior to the war. This profit was inadequate to enable the companies to provide for future development.

In April 1944 a memorandum presented to the Government by the Cornish Tin Mining Advisory Committee stated that there were good prospects of making important discoveries of tin ore in Cornwall and urged that a Metalliferous Mines Commission be appointed to foster the non-ferrous mining industry, and that State funds be provided to assist private mining or metallurgical enterprises. In Cornwall, the first charge on the capital would be the maintenance as producing concerns of the four largest mines: Geevor, South Crofty, East Pool, and Castle-an-Dinas. The memorandum also called for a revision of taxation as applied to wasting assets.

No Government action was taken on these recommendations, but in July 1945, the Minister of Fuel and Power appointed a small technical committee to consider whether there was justification in the national interest for granting assistance for underground exploration at the East Pool and Agar mine in the hope of finding additional deposits of tin ore. The committee's report has never been published.

In June 1945 the directors of East Pool and Agar, Ltd., advised their shareholders that unless assistance or new capital could be obtained the company would have to be liquidated. The Ministry of Supply's contract for the purchase of black tin had expired and it was impossible, owing to the low grade of ore, to operate within the Ministry's cost limits. Mining had therefore been discontinued.

The Future

Before the war it cost much more to produce tin in Cornwall than in Malaya, and since then the costs of mining, labor, materials, and fuel have increased substantially. If an immediate revival is required, it will be necessary for the Government to subsidize the industry, or to guarantee a profitable price of tin for about five years. If profitable production could be maintained for sufficient time to attract new capital to the industry, many old lodes could doubtless be reopened and new ones prospected.

In the past 140 years, more than three-quarters of a million tons of metallic tin has been obtained from Cornwall and it is probably true to say that there is still a large tonnage of tin in the ground. In recent times the Cornish lode mines have had difficulty in competing with the rich alluvial deposits of the Far East. At some time in the future, when the world's alluvial deposits of tin are exhausted, one may reasonably expect that Cornish mining will become active again.

Improved Barrel and Bit Increases Core Recovery

L. J. BURROWS, Diamond Drill Contracting Co., Spokane, Wash.

SEVERAL MODIFICATIONS in the design of the Duffield core-barrel have been made by the Diamond Drill Contracting Co., of Spokane, Wash., to facilitate greater core recovery and to enable the drill operator to determine instantly when the core-barrel becomes blocked or full. The original type of barrel designed by C. E. Duffield, mechanical and boring engineer of South Australia, was described in *E.&M.J.* of November 1944.

In the accompanying illustration, note the bottom-discharge feature of the bit, which was designed to prevent washing away of soft or talcky core. Normally water travels between the inner walls of the bit and the drill core during drilling. In this type, however, the water travels through holes in the bit walls and thus prevents loss of soft core material if encountered during drilling.

In the sectional view of the barrel, note that drilling water follows the course indicated by arrows, passing first through a cone valve, then through the inside of the sliding valve, then around the inner tube of the assembly, and finally out through the special holes in the drill bit.

Action of the assembly is best understood by studying the sequence drawings. When the inner tube of the barrel fills with core or becomes blocked it pushes the sliding valve back into the sliding-valve sleeve, thereby causing a slight increase in water pressure in the drill water line and which registers on the gage, that is provided in a convenient place for the drill operator. Immediately thereafter the cone valve closes as shown in Position 3, causing a pressure increase in the water line, which registers on the gage and notifies the driller to stop drilling.

As the inner tube recedes during this process, the core lifter slips off the inner tube and onto the core as shown in Positions 2 and 3. At no time until the core-barrel is either full or blocked does the lifter come in contact with the core. The purpose of the swivel is to permit the barrel assembly to rotate while the inner tube and contained core remain stationary.

When the driller starts to pull the rods out of the hole as shown in Position 4, the core lifter becomes wedged between the conical inner surface of the bit and the core, and grips the core. Simultaneously, the rotary motion of the assembly is transmitted to the core and breaks the core loose from the bottom of the hole as shown. Concurrently with this action, the conical water valve opens as the rods are withdrawn because of the pressure exerted by the compressed spring which rests against the shoulders encircling the conical valve seat. This releases the pent-up water pressure in the rods and prevents a "wet pull."

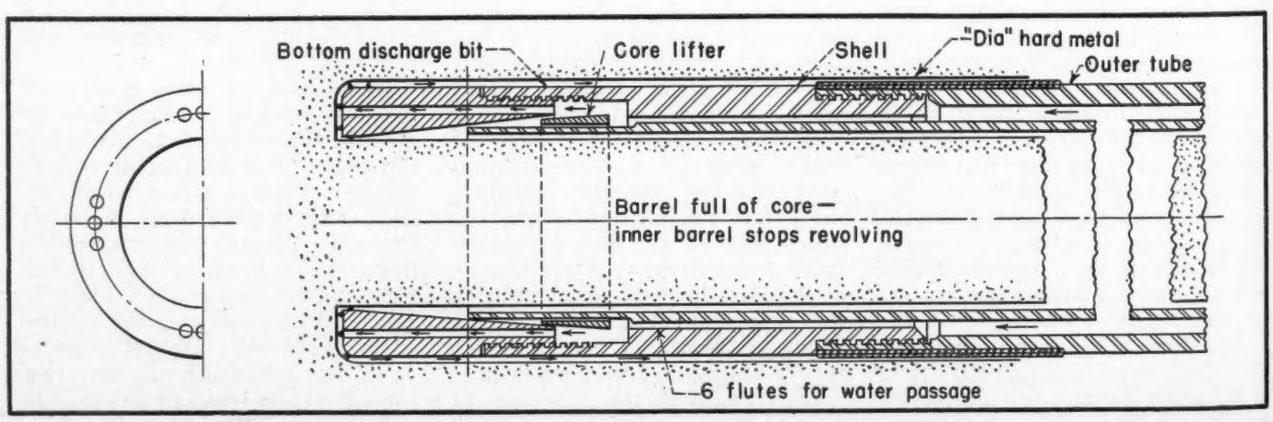
Starting at the end of the assembly, the previously discussed bottom-discharge feature of the bit constitutes the first change in design of the Duffield barrel.

Next, a rubber relief valve has been provided at the upper end of the inner tube, which allows the barrel to be lowered at a reasonable speed through water to the bottom of a hole, without starting the sequence of operations which would trip off the core lifter before drilling is started.

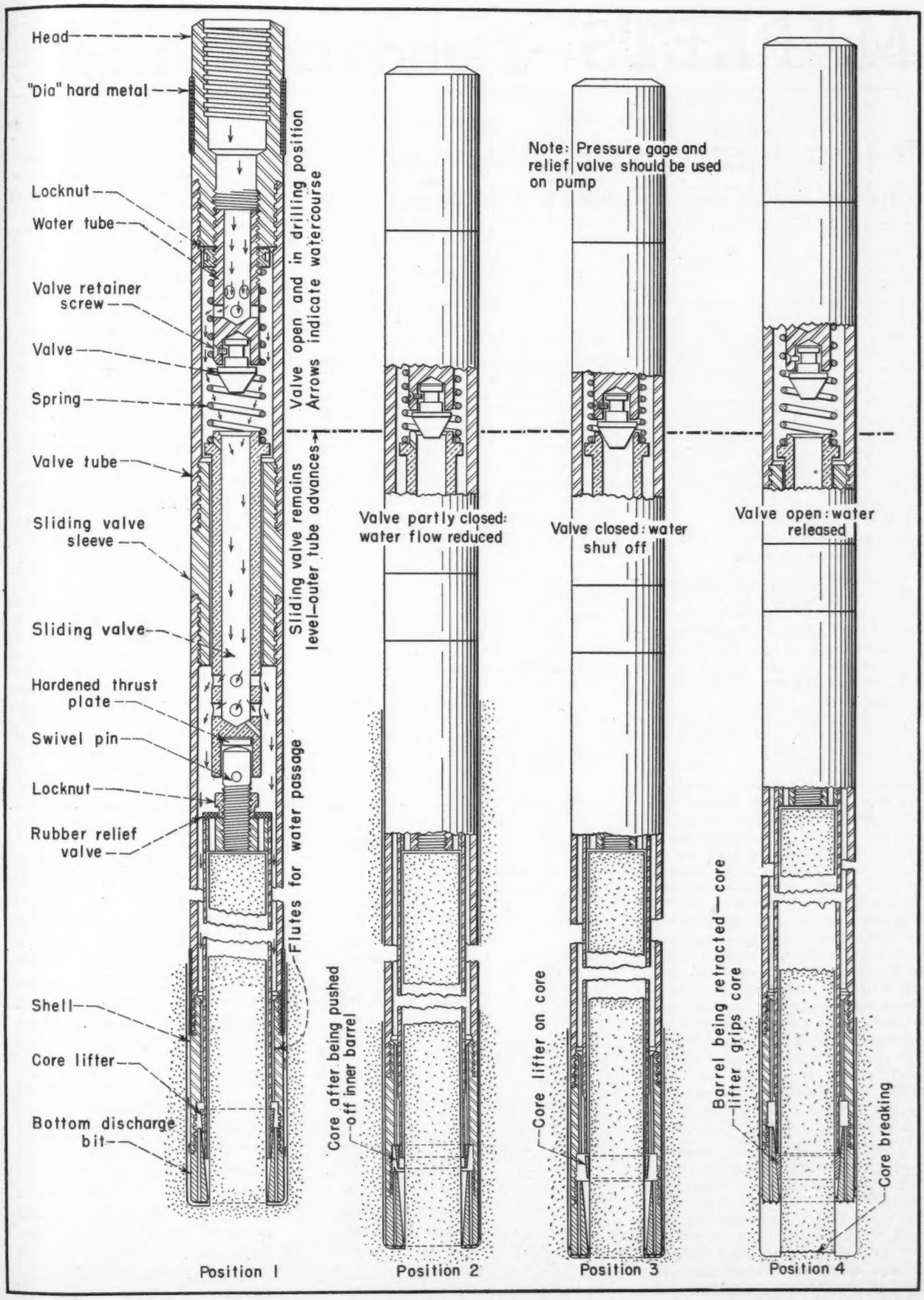
A hardened thrust plate is provided as a bearing surface for the swivel pin.

The sliding valve and sleeve, and the spring, are essentially the same as in the original Duffield design.

In the new design the cone valve replaces a second sliding valve used in the former design. This improvement provides a more positive water shut-off, and permits a simpler and more effective adjustment of the time interval between the closing of the valve and the tripping of the core lifter off of the inner tube.



CORE RECOVERY in soft ground is increased because drilling water discharges through special holes in the bit walls.



A CONE VALVE CLOSES as soon as the core-barrel fills up. This increases the water pressure registered on a gage at the drill, notifying the operator to stop drilling. Note that the core lifter engages the core only when the rods are withdrawn.

MARKETS—Trends and Prices

End of Control Held Nearer — Foreign Copper Higher — Zinc Ceiling Raised to 9¼c. Basis

REVERSAL OF THE ADMINISTRATION'S position on meat control was viewed as a most important development for all industry. Producers of non-ferrous metals believe that decontrol on meat and numerous other items announced after Oct. 14 points to a general collapse of OPA. However, it was felt in market circles that controls on copper, lead, zinc, and tin will be among the last to be removed. Continued price unsettlement in the security markets, and pronounced weakness in some obviously overpriced commodities, as cotton, exerted no influence on the metals. In fact, throughout October consumers took just about all of the copper, lead, and zinc that was available.

Outstanding in price developments was the action taken by the Office of Price Administration in reference to zinc. After long delay, the ceiling price of Prime Western zinc, East St. Louis, was raised 1c. per pound on Oct. 14, establishing the market at 9¼c. Though some producers of Prime Western regarded the new price as still too low, the High Grade division appeared to be more or less satisfied with the move, owing to the fact that competition with other materials in the field of die casting, and the threat of larger imports of High Grade, could not be ignored. In announcing the higher ceiling for zinc, OPA revealed that it was guided in its deliberations by the "world price" provisions of the Emergency Price Control Act. The new price, it was said, "is believed sufficient to avert reduction in imports of zinc, substantial in relation to domestic consumption." Members of the industry, with few exceptions, contend that the new price will have no influence on imports, particularly since the foreign market for metal has risen to between 10c. and 10½c. per pound on the ordinary grade. In regard to foreign prices, the differential between ordinary zinc and the higher grades is tending to narrow.

As October ended, there was general confusion over the price situation in the Joplin ore market. Smelters refused to raise their bids to more than $50 a ton for zinc concentrates produced in the Tri-State district, the price being the same as that paid before the price of zinc was raised to the higher level. Producers, on the other hand, refused to sell, holding that the higher price for metal should be reflected in the price of concentrate, or, in the event that the $50 basis is retained, OPA should adjust quotas for higher premium payments. The matter was under advisement as the month ended.

Consumption of copper by war-torn countries has been increasing steadily, and, to obtain metal urgently needed for reconstruction purposes, the price has played a minor part in recent transactions. The output of copper abroad has been below expectations, owing chiefly to strikes. Work stoppages retarded full production on various occasions this year in Chile, Northern Rhodesia, and Canada. At present, the Braden property of Kennecott, in Chile, is strikebound. Moreover, bulk buying of foreign copper by the British and the United States has greatly reduced the supply of free metal, making for a tight market in all directions. As October ended, virtually no November and December metal was available from foreign sources, and offerings of January copper became decidedly limited. Business was placed on the basis of 17½c., f.a.s. New York equivalent, an advance of approximately one-half cent for the month.

Consumption of virgin copper in the United Kingdom averaged more than 25,000 tons a month over the summer period, a high rate of activity. Stocks of virgin copper in the United Kingdom dropped from 123,100 tons at the beginning of the year to 80,900 tons on July 1. Consumption figures for other European countries are not available, but Sweden, Belgium, Switzerland, and Italy have been absorbing copper at a higher rate than most observers thought possible under prevailing upset conditions.

Statistics of the domestic copper industry show that production has been increasing ever since operations at refineries and the mines have returned to a more normal basis after settlement of widespread labor difficulties. During September, output of refined copper in the United States amounted to 67,803 tons, which compares with the low of 18,989 tons in April. Deliveries to domestic customers in September totaled 112,339 tons, of which 48,500 tons was foreign metal released by the Metals Reserve. The Government's stocks of copper have declined to less than 200,000 tons, and may drop to less than 150,000 tons by the end of the year. Total imports of copper (in ore, blister, and as refined metal) amounted to 298,166 tons in the Jan.-Sept. period of 1946. Shipping difficulties, resulting from strikes, cut down imports in August and September.

United States Copper Statistics

A summary of the United States copper statistics as reported by members of the Copper Institute, in tons, follows:

	Production		Deliveries to Customers			Refined
	(a) Crude	Refined	(b) Domestic	Export	Total	(c) Stocks
1941	1,016,996	1,065,667	1,545,541	307	1,545,848	75,564
1942	1,152,344	1,135,708	1,635,236	.....	1,635,236	65,309
1943	1,194,699	1,206,871	1,643,677	.....	1,643,677	52,121
1944	1,056,180	1,098,788	1,636,295	.....	1,636,295	66,780
1945	841,667	843,113	1,517,842	.....	1,517,842	76,512
1946:						
January	58,178	69,008	115,601	.....	115,601	72,799
February	41,667	49,923	86,089	909	86,998	74,339
March	41,832	20,139	58,590	.....	58,590	70,249
April	29,280	18,989	75,756	.....	75,756	65,448
May	31,897	20,551	93,647	.....	93,647	75,754
June	32,785	23,870	95,267	.....	95,267	79,145
July	56,906	43,606	96,826	.....	96,826	101,183
August	64,462	59,591	118,814	.....	118,814	94,669
September	69,689	67,803	112,339	.....	112,339	98,619

(a) Mine or smelter production or shipments, and custom intake including scrap. (b) Beginning March, 1941, includes deliveries of foreign copper for domestic consumption. (c) At refineries, on consignment, and in Exchange warehouses, but not including consumers' stocks at their plants or warehouses.

MARKETS—Trends and Prices

Actual consumption of copper in the United States, based on figures compiled for the fabricating division of the industry, amounted to 119,644 tons in August, the highest monthly total on record for a peacetime period. Shortages in various shapes and shipping complications caused consumption to drop slightly in September to 112,486 tons.

Increases of $2 to $4 per ton in premiums and toll charges for converting or casting refined copper into special shapes were approved by OPA, effective Oct. 14. Refiners raised the premiums in July, before OPA was revived, but were forced to go back to the old basis until official sanction finally restored the higher levels. Casting of special shapes, as slabs, cakes, and billets, naturally suffered during the period of uncertainty that obtained for more than two months.

The supply situation in lead under price control that has been far from realistic has not improved, and experts within the industry have come out strongly for removal of all controls, including those on end-use of the metal. At a meeting of the Primary Lead Advisory Committee, held in Washington on Oct. 31, leaders in the industry pleaded for decontrol. Kenneth C. Brownell, vice president of the American Smelting & Refining Co., estimated that the 1946 supply of lead, primary and secondary, will total around 770,000 tons. In a free market, he said, the available supply from all sourcess should increase to 955,000 tons in 1947. "Government control of lead has not been a success," Irwin H. Cornell, vice president and sales manager of St. Joseph Lead Co., told OPA officials. He also favored decontrol of lead and lead products and is confident that if this is done promptly lead will sell at a price that will bring the supply to a point that will take care of all essential demands, and this will be accomplished in the not far distant future.

The New York Official price of silver dipped to 89c. on Oct. 3. The reason for the unexpected drop was a sudden increase in offerings of Mexican metal accumulated when prices were substantially lower than at present. Offerings of foreign silver continued in good volume throughout October and con-

Major Metals

U. S. DAILY AND AVERAGE PRICES

	Electrolytic Copper		Straits Tin	Lead		Zinc
1946 Oct.	Domestic (a) Refinery	Export (b) Refinery	New York	New York	St. Louis	East St. Louis
1	14.150	16.900	52.000	8.25	8.10	8.25
2	14.150	16.925	52.000	8.25	8.10	8.25
3	14.150	16.675	52.000	8.25	8.10	8.25
4	14.150	16.925	52.000	8.25	8.10	8.25
5	14.150	16.925	52.000	8.25	8.10	8.25
7	14.150	16.775	52.000	8.25	8.10	8.25
8	14.150	17.225	52.000	8.25	8.10	8.25
9	14.150	17.175	52.000	8.25	8.10	8.25
10	14.150	16.800	52.000	8.25	8.10	8.25
11	14.150	16.800	52.000	8.25	8.10	8.25
12	Holiday	16.800	Holiday	Holiday	Holiday	Holiday
14	14.150	17.050	52.000	8.25	8.10	9.25
15	14.150	16.925	52.000	8.25	8.10	9.25
16	14.150	16.925	52.000	8.25	8.10	9.25
17	14.150	16.925	52.000	8.25	8.10	9.25
18	14.150	16.925	52.000	8.25	8.10	9.25
19	14.150	17.050	52.000	8.25	8.10	9.25
21	14.150	17.300	52.000	8.25	8.10	9.25
22	14.150	17.300	52.000	8.25	8.10	9.25
23	14.150	17.300	52.000	8.25	8.10	9.25
24	14.150	17.350	52.000	8.25	8.10	9.25
25	14.150	17.425	52.000	8.25	8.10	9.25
26	14.150	17.425	52.000	8.25	8.10	9.25
28	14.150	17.425	52.000	8.25	8.10	9.25
29	14.150	17.425	52.000	8.25	8.10	9.25
30	14.150	17.425	52.000	8.25	8.10	9.25
31	14.150	17.425	52.000	8.25	8.10	9.25
		AVERAGES FOR MONTH				
Oct.	14.150	17.094	52.000	8.250	8.100	8.865
		AVERAGES FOR WEEK				
2	14.150	16.817	52.000	8.25	8.10	8.25
9	14.150	16.950	52.000	8.25	8.10	8.25
16	14.150	16.883	52.000	8.25	8.10	8.85
23	14.150	17.133	52.000	8.25	8.10	9.25
30	14.150	17.413	52.000	8.25	8.10	9.25
Oct.		CALENDAR WEEK AVERAGES				
5	14.150	16.854	52.000	8.25	8.10	8.25
12	14.150	16.929	52.000	8.25	8.10	8.25
19	14.150	16.967	52.000	8.25	8.10	9.25
26	14.150	17.350	52.000	8.25	8.10	9.25

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Effective March 14, our export quotation for copper reflects prices obtaining in the open market and is based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.075c. for lighterage, etc., to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead are for common lead.

(c) Determined by Handy & Harman on the basis of market prices for bar silver, in cents per troy ounce .999 fine, in amounts of 50,000 oz. or more, nearby delivery, New York. Price quoted is in cents and one-eighth cent fractions, and is usually about one-quarter cent below the market to allow for delivery, carrying, and marketing. In addition to foreign silver, the quotation also applies to domestic and Treasury silver if such silver enters into the market. The Treasury's purchase price of newly mined domestic silver 90.5c. per troy ounce 1000 fine, effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

	Sterling Exchange	Silver		Gold	
1946 Oct.	"Checks"	(c) New York	London	London	(d) United States
1	403.000	90.125	55½d.	172s. 3d.	$35.00
2	403.000	90.125	55½d.	172s. 3d.	35.00
3	403.000	89.000	55½d.	172s. 3d.	35.00
4	403.000	90.125	55½d.	172s. 3d.	35.00
5	403.000	(e)	(e)	(e)	35.00
7	403.000	90.125	55½d.	172s. 3d.	35.00
8	403.000	90.125	55½d.	172s. 3d.	35.00
9	403.000	90.125	55½d.	172s. 3d.	35.00
10	403.000	90.125	55½d.	172s. 3d.	35.00
11	403.000	90.125	55½d.	172s. 3d.	35.00
12	Holiday	Holiday	(e)	(e)	Holiday
14	403.000	90.125	55½d.	172s. 3d.	35.00
15	403.000	90.125	55½d.	172s. 3d.	35.00
16	403.000	90.125	55½d.	172s. 3d.	35.00
17	403.000	90.125	55½d.	172s. 3d.	35.00
18	403.000	90.125	55½d.	172s. 3d.	35.00
19	403.000	(e)	(e)	(e)	35.00
21	403.000	90.125	55½d.	172s. 3d.	35.00
22	403.000	90.125	55½d.	172s. 3d.	35.00
23	403.000	90.125	55½d.	172s. 3d.	35.00
24	403.000	90.125	55½d.	172s. 3d.	35.00
25	402.875	90.125	55½d.	172s. 3d.	35.00
26	402.750	(e)	(e)	(e)	35.00
28	403.000	90.125	55½d.	172s. 3d.	35.00
29	403.000	90.125	55½d.	172s. 3d.	35.00
30	403.000	90.125	55½d.	172s. 3d.	35.00
31	403.000	90.125	55½d.	172s. 3d.	35.00
		AVERAGES FOR MONTH			
Oct.	402.986	90.076	55½d.	—	35.00
		AVERAGES FOR WEEK			
2	403.000	90.125	—	—	—
9	403.000	90.125	—	—	—
16	403.000	90.125	—	—	—
23	403.000	90.125	—	—	—

Calendar week averages, New York Silver: Oct. 5th, 89.900; 12th, 90.125; 19th, 90.125; 26th, 90.125.

(e) Not quoted (Saturday).

MARKETS—Trends and Prices

sumers experienced no difficulty in satisfying their needs. Domestic newly mined silver produced on and after July 1 is now moving to the Treasury, reducing pressure from that source. Receipts of silver in the form of scrap have increased appreciably.

Platinum traders had an exciting time. Demand for the precious metal at $90 an ounce soon dried up, and as selling pressure came into the market the price declined sharply to $69. At the lower level there was some improvement in demand. Important operators in platinum never did approve of the sharp rise that took place after price control was lifted.

A fairly long period of price stability in quicksilver ended after it became known that Italian metal was available in quantity on the basis of about $82.50 per flask, duty paid, New York. Spot metal declined to $93 per flask, with the undertone easy. Rumors that the Cartel is to be revived served to check bearish sentiment.

Antimony and cadmium remain in short supply.

Miscellaneous Metals Monthly Averages

Average prices of miscellaneous metals for September and October:

(a) New York, packed in cases, in lots of 5 tons or more but less than a carload. (b) Nominal. (c) Producer's price for commercial sticks. (d) Average producers' and platers' quotations. (e) Special shapes sold to platers.

	Sept.	Oct.
Quicksilver, N. Y. flask	96.000	95.192
Antimony (a)	15.839	15.839
Antimony, bulk, Laredo	14.500	14.500
Antimony, bulk, N. Y.	15.265	15.265
Antimony, Chinese (b)	16.500	16.500
Platinum, oz. troy	85.417	76.731
Cadmium (c)	125.000	125.000
Cadmium (d)	127.500	127.500
Cadmium (e)	130.000	130.000
Aluminum ingot	15.000	15.000

E & M J Price Index

Weighted index of non-ferrous metal prices (copper, lead, zinc, tin, silver, nickel, and aluminum). The average for the years 1922-1923-1924 equals 100.

1929	110.33	1937	90.86
1930	82.87	1938	73.67
1931	60.20	1939	77.71
1932	48.26	1940	79.22
1933	59.79	1941	83.49
1934	65.59	1942	86.80
1935	74.66	1943	88.74
1936	73.45	1944	88.74
		1945	90.86

	1944	1945	1946
January	88.74	88.74	96.42
February	88.74	88.74	96.42
March	88.74	88.74	96.42
April	88.74	88.74	96.42
May	88.74	88.74	96.42
June	88.74	88.74	107.16
July	88.74	88.74	117.11
August	88.74	88.74	113.32
September	88.74	91.16	113.32
October	88.74	96.40	114.25
November	88.74	96.42	....
December	88.74	96.42	....

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

MISCELLANEOUS METALS

(October 31, 1946)

Aluminum, ingot, 99 plus percent, lb.	15c.
Antimony, domestic, spot, lb., 5 tons or more	15.839c.
Bismuth, ton lots, lb.	$1.60
Cadmium, commercial sticks, lb.	$1.25
Calcium, lb. ton lots, 97 @ 98 percent, cast	$1.85
Chromium, 97 percent grade, lb.	89c.
Cobalt, 97 to 99 percent, per lb.	$1.50
Indium, troy oz.	$2.25
Nickel, electrolytic cathodes, lb.	35c.
Magnesium, 99.8 percent, carloads, lb.	20½c.
Palladium, troy oz.	$24.00
Platinum (Official quotation wholesale lots) troy oz.	$69.00
Quicksilver, flask of 76 lb., 25 flasks or more	$93.00
Selenium, 99.5 percent, lb.	$1.75
Silicon, minimum 97 percent, spot, carloads, lb.	14.75c.
Tellurium, lb.	$1.75 nom.
Thallium, 100 lb. or more, lb.	$17.50
Titanium, 96 to 98 percent, lb.	$5.00

METALLIC ORES

Beryllium Ore, 8 to 12% BeO, f.o.b. mine, per unit	$8.00@$10.00
Chrome Ore, per long ton, f.o.b. cars Atl. ports, dry 48% Cr_2O_3, 2.8 to 1 ratio (Prices nominal)	$38.00@$39.00
48% Cr_2O_3, 3 to 1 ratio	$40.00@$41.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$5.45
Mesabi bessemer	$5.20
Old Range non-bessemer	$5.30
Mesabi, non-bessemer	$5.05
Lead (Galena) 80 percent, Joplin, Mo., ton	$99.90
Manganese, Metals Reserve Co. sales price, per long-ton unit of Mn contained, 48 percent, subject to premiums and penalties, effective May 15, 1944: 85c. (duty paid) New York, Philadelphia, Baltimore, Norfolk, Mobile, and New Orleans; 91c., Fontana, Calif., Provo, Utah, and Pueblo, Colo. (Current prices in open market nominal at 73@75c. per long-ton unit.)	
Molybdenum Ore, 90%, per lb. of MoS_2 f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Foreign, 60 percent, duty paid	$22.00
Domestic, scheelite, 60 percent and upward	$24.00
Vanadium Ore, per lb. of contained V_2O_5 f.o.b. mines	27½c.
Zinc Ore, Prime, 60 percent concentrate, Joplin, Mo., per ton	$50.00

METALLIC COMPOUNDS

Arsenious Oxide (arsenic trioxide) lb., in bbl., carload lots	5c.
Cobalt Oxide, 70 to 71 percent, lb.	$1.06
Copper Sulphate, 100 lb.	$5.65

ALLOYS

Beryllium Copper, 2.5 to 3 percent Be, per lb. of contained Be	$14.75
Ferrochrome, 65 to 70 percent per lb. of Cr contained	13c.
Ferromanganese, 78 to 82 percent, gross ton	$135.00
Ferromolybdenum, 55 to 65 percent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 percent, per lb. of contained Si	6.60@8.10c.
Ferrotungsten, 75 to 80 percent, lb. of W contained	$1.90
Ferrovanadium, per lb. of V delivered	$2.70@$2.90
Silicomanganese, 1 percent C, gross ton	$138.00

NON-METALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (U.S funds), ton:	
Crude No. 1	$650@$758
Crude No. 2	$165@$385
Spinning fibers	$124@$233
Paper stock	$44@$49.50
Shorts	$14.50@$26.50
Vermont, f.o.b. Hyde Park:	
Shingle stock	$62.50@$65.00
Paper stock	$44.00@$53.00
Shorts	$14.50@$28.50
Floats	$19.50
Barytes, f.o.b. mines:	
Georgia, crude, per long ton	$8.50@$9.00
Missouri, 93 to 94 percent $BaSO_4$, per short ton	$8.25@$8.50
Bauxite, long ton:	
Domestic, crude, 50 to 52 percent (not dried)	$5.00
Domestic, chemical, 55 to 58 percent	$7.50@$8.50
Domestic, abrasive, 80 to 84 percent	$16.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$15.00
Feldspar, bulk ton:	
Potash feldspar, 200 mesh	$17.00
Glass spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 60 percent, all rail movement, ton	$30.00
Acid 98 and 1 percent, bulk, ton	$37.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton dead-burned, f.o.b. Washington	$22.00
Mica: Domestic producers quote on punch and sheet as follows: Punch, 22c. per pound; 1½x2 inch, $1.10; 2x2 inch, $1.60; 2x3 inch, $2.10; 3x3 inch, $2.75; 3x4 inch, $3.50; 3x5 inch, $4; 4x6 inch, $5. Wet ground, very fine, $90 per ton. Special grades command premium. Bulk sales dry ground, $32.50 per ton. Scrap, $28 per ton and up.	
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c i f, Atlantic ports	12c. nom.
Silica, in bags, 325 mesh, ton	$20.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
Vermont, extra white, 200 mesh	$9.50@$10.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton: Basic	$28.00
Steel, base price, Pittsburgh Billets, gross ton	$39.00
Structural shapes, 100 lb.	$2.35

WASHINGTON REFLECTIONS

McGRAW-HILL WASHINGTON NEWS BUREAU

Movement Is on Foot to Make Subsidies Permanent

Advocates of continued subsidy help to marginal non-ferrous metal mines, worried over possible cancellation of the Premium Price Plan for copper, lead, and zinc, have evolved a plan to place subsidies under a permanent agency.

Senator Ernest McFarland, in a tour of Arizona with Secretary of the Interior Krug late in October, reportedly urged the Secretary to accept the plan as a permanent division within the Interior Department. If Mr. Krug does not fall in with the idea, second choice would be RFC Office of Metals Reserve.

Disruption of the Premium Price Plan became a real threat last month with announcement by CPA officials that the agency was endeavoring to wind up its business by the first of the year. OPA, if not thrown out immediately after Congress meets, will probably fold up by March 1. These two agencies carry the entire work load in setting the quotas which determine payments. The remaining agency, RFC, is now merely a disbursement agency for the plan.

Devious Reasons Offered for Small Zinc Increase

In mid-October, OPA raised the ceiling on zinc from 8.25c. to 9.25c. per pound. The reasons stated constitute a classic example of bureaucratic duplicity.

The real reasons for the price increase were to relieve the distress of domestic smelters burdened with high costs and to increase the flow of concentrates from abroad. The small increase given was inadequate for either purpose. However, it was more or less satisfactory to producers of high-grade metal, who are worried over aluminum and plastic competition.

In explaining the increase, OPA invoked the famous 10-X clause of the Act, which renewed price control in July. This clause demands that when the import price of an essential commodity exceeds the domestic ceiling, the ceiling price of imports shall be raised to prevent a reduction in imports or curtailment of domestic trade. However, in making an appearance of conforming to clause 10-X, OPA did not raise the price to the obvious level necessary to assure imports—namely, the current price-plus-duty of 11c. Instead, it dismissed the current price as "speculative" and fell back on a three-month average.

The increase also precipitated a row between smelters and Tri-State miners over the price of Tri-State concentrates. The miners expected, according to custom, an increase in the concentrate price, particularly because, according to the Premium Price Plan formula, the subsidy for Joplin concentrates would be reduced $10.80. The smelters pointed to their higher costs and insisted that the concentrate price should be unchanged.

German Metallurgical Plants Available for Purchase

Eighty-five non-ferrous metal plants in Germany, which have been officially approved for reparation by the Allied Control Council in Berlin, are up for allocation by the Council as between the Inter-Allied Reparation Agency and the USSR. The plants allocated to IARA will be re-allocated by that agency among its 18 member Western nations, including the United States, which will get 12 percent.

Included in the list are plants which were engaged in ore dressing, smelting and refining, and the production of ingots, semi-fabricated and finished wrought, cast, and forged products of primary and secondary aluminum, magnesium, copper, lead, zinc, tin, nickel, beryllium, manganese, vanadium, and alloys thereof.

The Office of International Trade invites business firms and persons to indicate any interest which they may have in the purchase of any of the 85 non-ferrous metal plants, in the event they are allocated to the reparation account of the United States. Such expressions of interest should be addressed to the Reparations Staff, Office of International Trade, Department of Commerce, Washington 25, D. C., and should be received as soon as possible.

U. S. May Protect Mineral Investments Abroad

On Oct. 25 William L. Clayton, Undersecretary of State for Economic Affairs, said that the United States should give greater support to American investments in foreign production of minerals essential to our economy. He specifically mentioned bauxite, manganese, nitrates, chromium, tin, copper, petroleum, and high-grade iron ore.

Although Mr. Clayton denied that the Government has not protected American investments abroad, the general feeling among Americans involved in foreign mining is that the Government has given them virtually no support. Apparently Mr. Clayton's statement presages a change of policy. However, he made it clear that the change applies only to minerals for which we are dependent on foreign sources of supply, at least in part.

Committee May Recommend More Government Meddling

On Capitol Hill there is a developing line of thinking that war plant disposal should be taken away from War Assets Administration, given to a new Governmental agency especially created for the job, and perhaps called a Government Facilities Administration.

The idea can be expected to take tangible form in hearings now scheduled to begin on Dec. 10 before the Senate (Murray) Small Business Committee. Guinea pig for the hearings will be the Government's light-metals plants, the outstanding case to date in which broad economic objectives have dictated disposal policy.

The Committee is not limiting its thinking of a projected Government Facilities Administration to something that would be a disposal agency set up to work itself out of a job. In the back of members' minds, too, is the thought that such an agency should look into the broader question of national adequacy of production facilities in the various industries in which Government has plants. And, in looking, it will doubtless do more than pause over the question of ownership of present facilities, and the possibility of setting up rival operators to the "big" companies.

WASHINGTON BRIEFS

Magnesium—Bids will close Dec. 2 on purchase or lease of the large magnesium (Pidgeon process) and ferro-silicon plants at Spokane, Wash. These were operated by Electro Metallurgical Co. during the war.

Safety—Bureau of Mines has issued I.C.7387, comprehensively summarizing safety practices for mines, mills, and metallurgical plants.

Bauxite—The voluminous data from the USBM wartime investigations of Arkansas bauxite are open to inspection at the Bureau's Washington office and at the Arkansas capitol.

Continued Control—OPA announcement of Nov. 1 forecast abandonment of all price controls except lumber, paper, and metals. Probably, under the circumstances, these cannot last long.

Tri-State—According to a USBM survey, R.I.3922, the Tri-State reserves are estimated at 51 million ore tons, valued at $171 million at present prices.

NEWS OF THE INDUSTRY

Health Aims Discussed by St. Joseph Lead Official

Development of healthy conditions should be the one common meeting ground of agreement between management and labor, and not a subject of collective bargaining, according to Andrew Fletcher, executive vice president of the St. Joseph Lead Co., in a talk given Oct. 1 before the seventh annual Congress on Industrial Health, American Medical Association, in Boston, Mass. Mr. Fletcher, who is also president of the Industrial Hygiene Foundation, spoke on the subject, "New Horizons in Industrial Health and Welfare."

The St. Joseph Lead Co., Mr. Fletcher pointed out, is the largest miner of lead in the United States as well as a major producer of zinc metal and oxide. His company, he said, "thoroughly realizes from its own experience over a long period of years that dollars invested in improved working and living conditions pay large dividends in dollars, as well as human happiness."

Stating that health should not be a subject to be "pulled apart, shoved around, and bargained about," Mr. Fletcher expressed concern over recent propaganda for including stated periods of paid sick leave in union contracts. Wage rates should continue to make reasonable allowance for sick absenteeism, and if not adequate in this respect should be increased. But more than a reasonable limit of time off for sickness, he asserted, has the indirect effect of an increase in pay rates, and will have the direct result of producing increased absenteeism and higher operating costs.

Records of absenteeism, based on employees' own statements to the company, were cited to show that over a six and one-half year period time lost through sickness averaged less than five days per year on a six-day-a-week working schedule. This figure contrasts with sick-leave allowance of 15 days a year requested by the union in wage negotiations at the company's southeast Missouri operations.

Sickness and hospital insurance coverage, it was noted, is another health matter which is wrongly tending to enter into collective bargaining. The opinion was expressed, on the basis of detailed records compiled by the St. Joseph Lead Co., that such coverage can be carried more cheaply by the individual employees, or by their union, than by an insurance company. If the employer pays any portion, it is solely an indirect pay increase, and advantage is bound to be taken of the policy to "liberalize" claims.

Addressing the same meeting on "Facts and Fallacies of Lead Exposure," Felix E. Wormser, secretary of the Lead Industries Association, took cognizance of erroneous impressions, held both by members of the medical profession and by laymen, that all paint contains lead and that exposure to lead poisoning is a necessary consequence of exposure to paint.

The lead-consuming industries, Wormser asserted, have undeservedly been criticized for creating hazards to public health. He cited several typical examples of alleged lead poisoning in which subsequent impartial scientific investigation gave lead a clean bill of health.

Strike of Miners Closes Braden Copper Co.

Mining operations of the Braden Copper Co. at Sewell, Chile, came to a standstill on Oct. 2, when a strike was called following a prolonged period of labor unsettlement. Approximately 3,500 men, comprising the underground force, are involved.

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Walkout Causes Shutdown Of Missouri Lead Mines

A walkout of 3,400 members of the International Union of Mine, Mill and Smelter Workers caused a complete shutdown of the St. Joseph Lead Co.'s mines and mills in southeast Missouri on Oct. 23. Settlement was brought about on Oct. 29 when the men signified they would return to work on Nov. 1 and agree to arbitration of the dispute. The strike was called without warning following earlier refusal of the union to accept arbitration in the case of an underground employee who had been discharged for insubordination. Despite unanimous agreement of the local grievance committee that the man's discharge was warranted, the union district representative and executive committee protested the action and rejected an offer submitted by the management to present the case for review to an impartial arbiter.

A probable loss of 3,500 tons of lead for November delivery resulted from closing of the Herculaneum smelter due to lack of concentrates.

The St. Joseph Lead Co.'s mines have been supplying one-third of all newly mined lead in the United States. During and since the war there have been no interruptions of operations due to labor disputes.

A statement released by the company on Oct. 23 said, in part: "The St. Joseph Lead Co. is deeply conscious of the damage to the economy in general, and the lead consuming industry in particular, of the resultant loss of production from its mines . . . the issue is clearly a question of maintaining efficient mining operations, and on the right answer to this question depends not only the well-being of the company but of the labor force itself."

Mining and Metallurgical Society Discussions Weigh Future Non-Ferrous Metals Economy

The economics of non-ferrous metals in relation to prices, subsidies, premium payments, stockpiling, cartels, and tariffs were discussed at a meeting of the Mining and Metallurgical Society of America held in New York on Oct. 15. A general expression of views on these subjects by Evan Just, editor of *Engineering and Mining Journal*, was followed by comments from representatives of the copper, zinc, and lead mining industries.

Price control, Just declared, has outlived its usefulness but cannot be dismissed without reservations. Our economy is vulnerable to sags in confidence. Production control, by producers or by Government, is one of the obvious stabilizing devices. The organization of compacts, such as mineral cartels, is the only tool so far developed to forestall undue hardship to raw-materials producers. Cartels should be operated by the people who know the business best, with Government participating only as an observer in the public interest.

Premium price subsidies as a permanent policy, Just continued, involve

(*Continued on page* 132)

EXIDE-IRONCLADS

FOR EXTRA POWER . . . FOR GREATER SAFETY

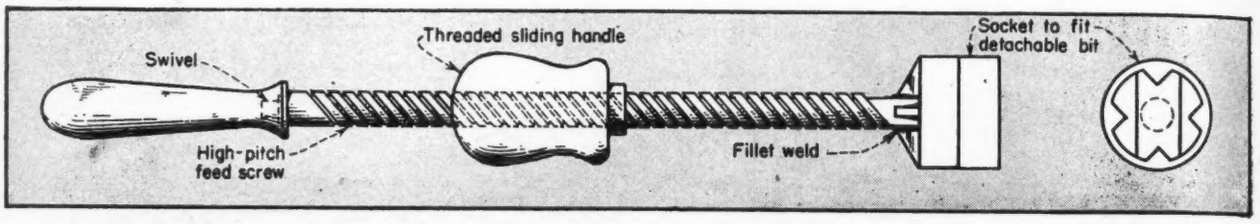
Maximum power . . . and maximum safety . . . are assured in mines, quarries and tunnel operations where haulage units are powered by Exide-Ironclads. These rugged, dependable batteries are specifically designed for heavy-duty service . . . to assure peak performance in trammer, locomotive and shuttlecar operation . . . to speed up production . . . and to keep down haulage costs.

Exide-Ironclads have the *high power ability* required for frequent "stop and go" service . . . a *high maintained voltage* throughout discharge . . . and a *high capacity* that assures sustained speeds throughout the day with full shift availability. You can always count on Exide-Ironclads for dependability, long-life, safety, economy and ease of maintenance.

If you have a special battery problem, or wish more detailed information, write for booklet Form 1982.

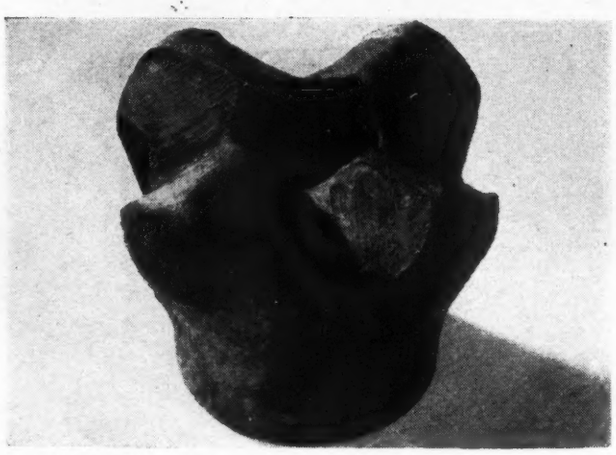
OPERATING IDEAS

Attaching Device Fills Bit Racks Rapidly



Much time and effort can be saved in attaching detachable bits to portable drill racks with the device illustrated, which was developed by Herman Lind, master mechanic at the Santa Barbara unit, American Smelting & Refining Co., Santa Barbara, Chihauhua, Mexico. A threaded sliding handle is pushed forward and imparts a twist to a threaded rod, to which is welded a socket constructed to fit over the bit wings. A swivel at one end of the rod permits free rotation of the screw and socket assembly.

Larger Watercourse in Bit Increases Drilling Speed



At the Santa Barbara unit of the American Smelting & Refining Co., Santa Barbara, Chihuahua, Mexico, a bit alteration developed by Herman Lind, master mechanic, is claimed to result in 15 to 20 percent faster drilling with no loss of wearing qualities.

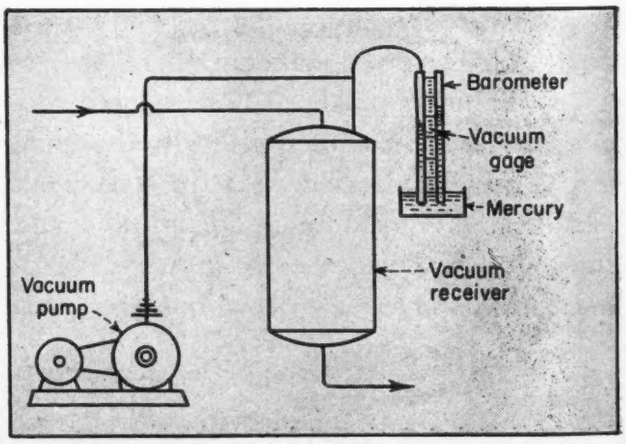
The alteration is made by punching out the ordinary watercourse in the bit to $\frac{3}{4}$-in. diameter. The benefit seemed to result from the fact that less rock is actually ground up by the bit in the course of drilling a given footage, as the central area represented by the watercourse is smashed up and disposed of in large pieces without wearing the face of the bit.

An enlarged watercourse is illustrated in the accompanying photograph of a bit which was taken previous to the milling of the bit.

Barometer Aids Operators of Precipitation Unit

It is necessary to maintain the vacuum in the vacuum receiver of the Crowe precipitation unit within fairly close limits to assure efficient operation. The vacuum gage reading will vary considerably because of changes in atmospheric pressure, and not necessarily as a result of leaks or mechanical troubles. To eliminate this element of doubt, a barometer was installed next to the vacuum gage at the mill of Kerr-Addison Gold Mines, Ltd., Virginiatown, Ontario.

George Hawkes, metallurgist, who submits this schematic diagram, writes that this installation enables operators to determine exactly what degree of variation is due to atmospheric pressure, and permits control of the equipment with greater accuracy and confidence. The barometer reading indicates the height to which the mercury would rise if a perfect vacuum were maintained in the equipment.



Meeting Steel Requirements

the Hard Way—

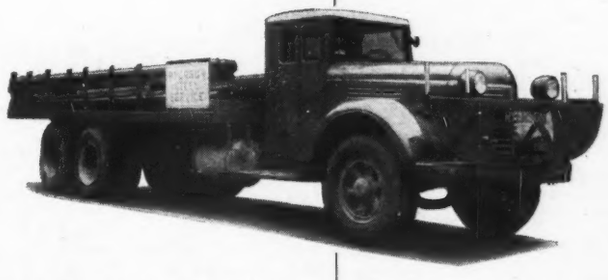
But Still Meeting Them!

A manufacturer of coal mining drills was desperate for 2½" x 2½" x ¼" square tubing needed for drill supports, on an order scheduled for shipment halfway around the world. The required size of tubing was nowhere available, but Ryerson Steel Service was equal to the occasion.

By forming two channels from ¼" plate and welding the channels together we were able to deliver several hundred pieces of the required tubing! While such an emergency measure is obviously not always practical, it did make it possible for the customer to complete his order and ship on schedule. And this is but one of numerous instances where Ryerson service has achieved the seemingly unachievable.

There are many requirements that we cannot handle today, but it is often surprising what can be done with the close cooperation of your nearby Ryerson plant. If needed steel is out of stock the Ryerson salesman will sometimes be able to suggest a practical alternate steel, or he may know a way in which flame cutting, forming or welding can serve to provide a workable substitute.

So we urge you to keep in touch with us. Our whole organization is doing everything within its power to help every customer get the steel he needs.



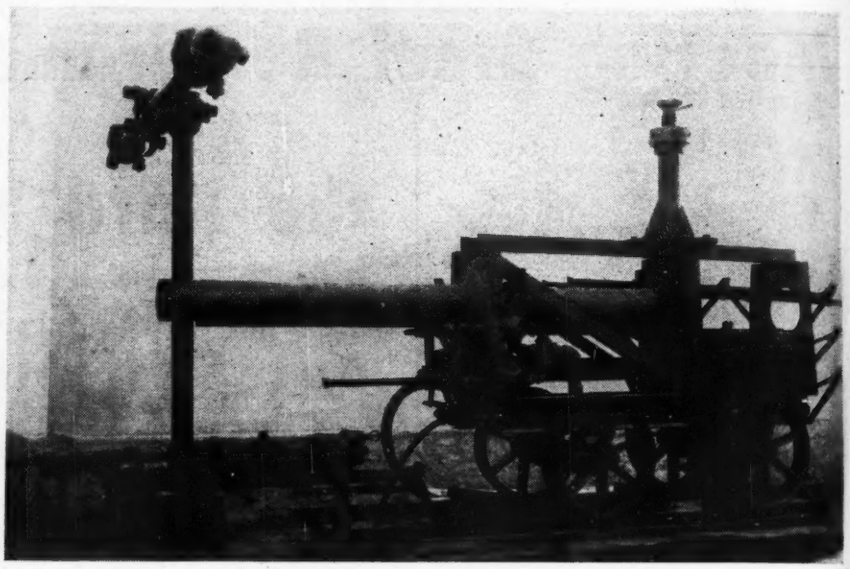
JOSEPH T. RYERSON & SON, Inc., Steel-Service Plants at: Chicago, Milwaukee, Detroit, St. Louis, Cincinnati, Cleveland, Pittsburgh, Philadelphia, Buffalo, New York, Boston

RYERSON STEEL

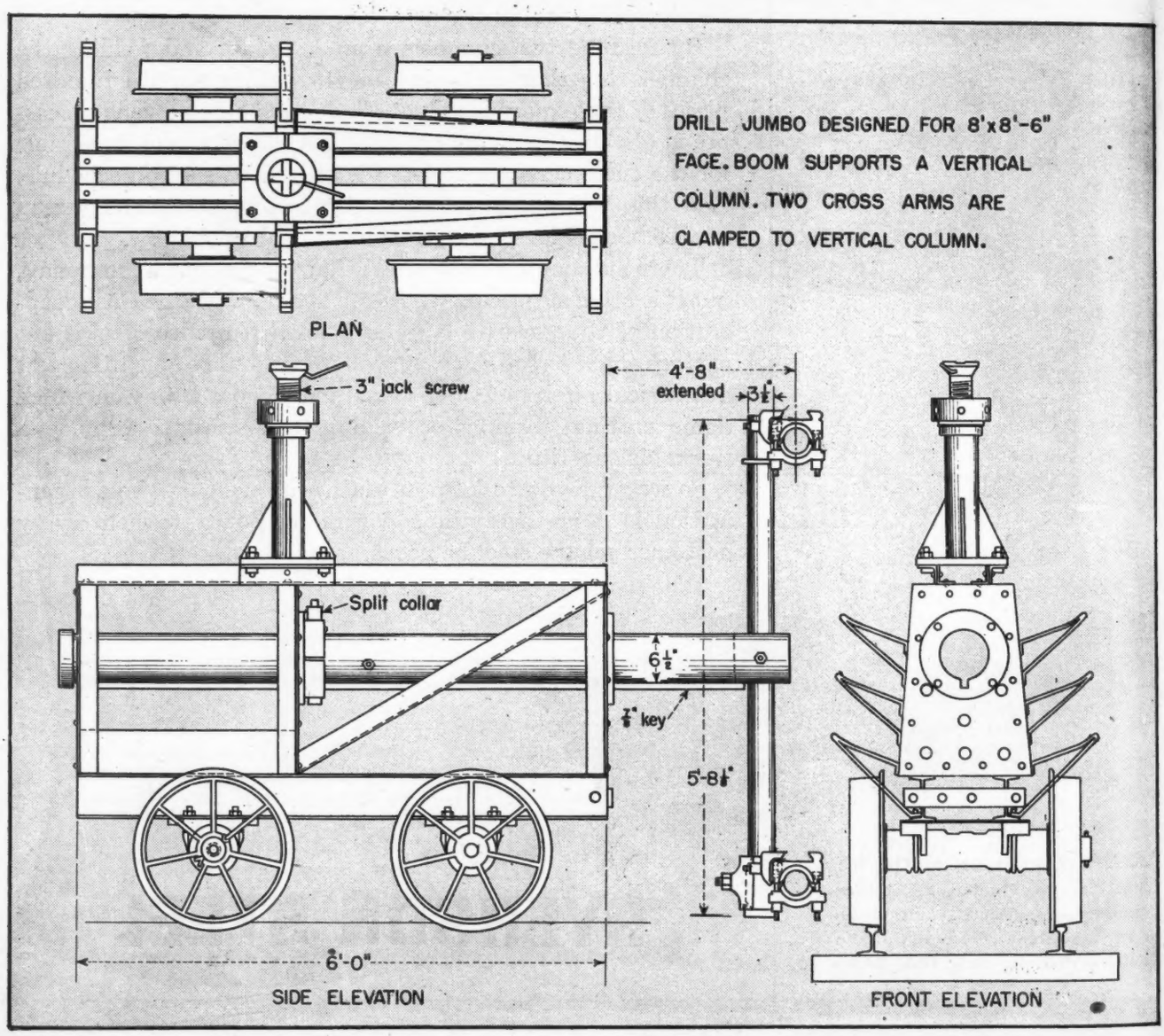
Retractible Boom on Jumbo Supports Drill Column

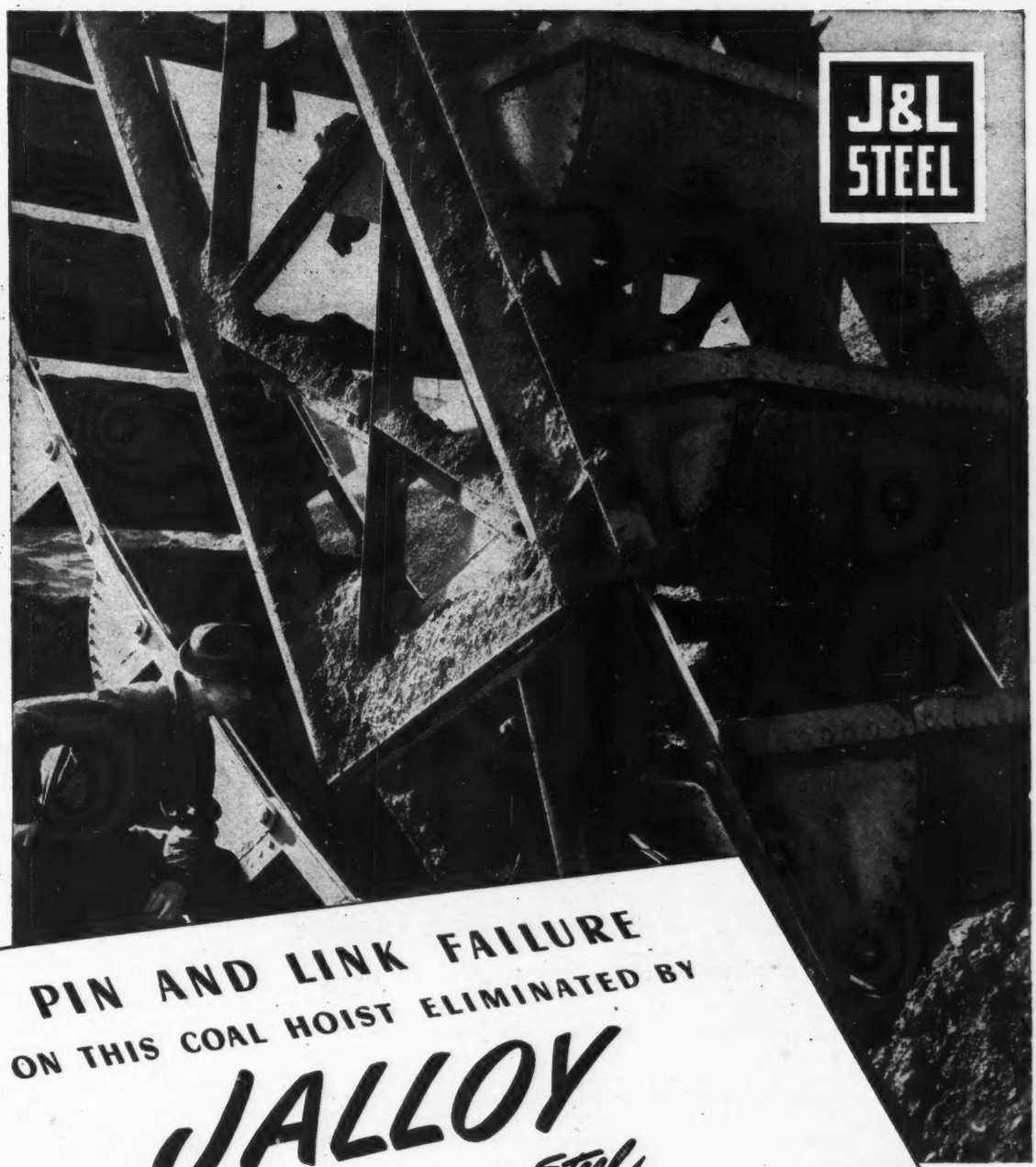
The retractible boom on this drill jumbo, devised by A. F. Horle, superintendent of the Parral Unit, American Smelting & Refining Co., Parral, Chih., Mexico, provides ample workroom for miners behind the drills and permits positioning of the machines close to the face while the carriage is blocked to slide rails or short rails which are not generally advanced to the face.

Stability of the jumbo is provided by the 3-in. jackscrew which blocks the carriage to the rails, and the 6-in. diameter sliding boom, which is keyed to the carriage frame by a long $\frac{7}{8}$-in. key and clamped by a heavy split-collar and setscrew.



BOOM OF JUMBO is extended. Note convenient position of water connections.





PIN AND LINK FAILURE ON THIS COAL HOIST ELIMINATED BY JALLOY

The Tank Armor Steel

Maintenance on the coal hoist above was a constant problem because of repeated failure of the links and pins on the bucket conveyor. All pins and links were replaced with new ones made of Jalloy, the special J&L steel made for tough jobs involving heavy impacts and dynamic stresses. Since then down-time because of pin and link failures has been eliminated—costly maintenance work has been avoided. Write for information about Jalloy steel.

JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH 30, PENNSYLVANIA

PERSONAL NEWS

Frank W. Bowdish has been appointed assistant metallurgist in the research department of Oliver Iron Mining Co. at Duluth. A native of Montana, Mr. Bowdish has been employed as a research engineer at M.I.T. for the past three years. His previous experience included employment with the Anaconda Copper Mining Co. at Butte, Mont.; Eudora Mining Co. at Kalispell, Mont., and the Caterpillar Tractor Co. in Peoria, Ill.

A. W. Veitch, general superintendent of two phosphate properties owned by Cia. Serrano S. A., Ipanema F.E.S., Sao Paulo, Brazil, who had been vacationing in England, returned to his post in October.

Frank E. Briber has joined the staff of the mining and metallurgical department of the Stearns-Roger Manufacturing Co., Denver 2, Colo.

E. G. Rawlins has succeeded **J. F. Berry** as manager of the Moctezuma Copper Co., with headquarters at Nacozari, Sonora, Mexico.

Paul M. Giever has been appointed director of the Industrial Hygiene Division of the Montana Board of Health, succeeding **Dohrman H. Byers**, of the Federal Public Health Service, who was loaned to the Division during the war. Mr. Byers has returned to Washington, D. C.

Robert P. Porter, of Spokane, Wash., prominent Pacific Northwest mining man, has been named to the board of regents of Gonzaga University at Spokane. Mr. Porter is president of Porter Brothers Corporation and is interested in mining development and operation in Montana, Idaho, and Oregon. He is also president of the Montana Mining Association.

Carl J. Trauerman, of Butte, Mont., has resigned as a director and president of the Ruby Gulch Mining Co. of Zortman, Phillips County, Mont. He was succeeded in the board by **Virginia Whitcomb Willett**, of Zortman, **Mamie Whitcomb Engle**, secretary-treasurer of the company, was elected to the board to succeed **T. O. Hammond**, of Helena, who resigned a few months ago. **Ray Jenkins**, of Butte, was appointed consulting engineer. Trauerman took a major part in the successful resumption of operations of the property in 1935.

Frederick William Bloecher, Jr., has been appointed instructor in mining engineering at Lafayette College. He received the degree of batchelor of science in mining engineering from Lehigh University in October, 1944, graduating with honors. **Bernard Joseph Fisher** has been appointed instructor in metallurgy at Lafayette.

Edward S. McGlone, who succeeds **Daniel M. Kelly** as vice president in charge of Western operations for Anaconda Copper Mining Co., is, at 47, one of the youngest high executives in the metal-mining industry. He received his E.M. degree from the Colorado School of Mines, where his athletic achievements on football and baseball fields established a lasting

EDWARD S. McGLONE

reputation in those sports. He has been with Anaconda since 1924, working his way from miner and sampler to shift boss, foreman, and other executive posts to general manager of Western mining and metallurgical operations in 1945. He served in the U. S. Army in the first World War and is popular throughout Montana. **Daniel M. Kelly**, who, as recorded in the October issue of *E.&M.J.*, retired in September, had been associated with the company for more than 31 years. He came to Anaconda in 1915 after a distinguished legal career and notable public service as Attorney General of Montana. He will continue to maintain offices at the Butte, Mont., offices of the company.

Dr. William R. Chedsey has been appointed professor of mining engineering in the department of mining and metallurgical engineering at the University of Illinois. **George B. Clark** has been appointed assistant professor of mining engineering at the University.

Edwin Sweetman, mining engineer and geologist, until recently with the Reconstruction Finance Corporation and also supervising engineer of the Steep Rock Iron Mine project, Atikokan, Ontario, has returned to his home in Green Bay, Wis.

LeRoy Salsich, president of the Oliver Iron Mining Co., Duluth, Minn., was on Oct. 16 awarded the Lawrence Saunders Gold Medal for 1947 by the board of directors of the A.I.M.E., for his "significant contribution, as operating head of the world's largest mining enterprise, to the nation's production of steel so vital to victory in World War II."

W. H. Straley III, formerly with the Board of Economic Warfare in Washington, has been named associate professor of geology at the Georgia School of Technology, Atlanta. Professor Straley was at one time professor of geology at North Carolina State University and at Baylor University, Texas. He received his doctor's degree from the University of Chicago.

Attention, Old Students Royal School of Mines

Engineering and Mining Journal has been requested to publish the following notice:

"Will any past Student of the Royal School of Mines, London, who has not received a form asking for his particulars for insertion in the forthcoming Register of Old Students please communicate at once with the Secretary, Dr. J. H. Watson, Royal Mint, London, E.C.3, England. Will any Old Student who has received such a form and has not yet filled it in and returned it, please do so as soon as possible."

OBITUARIES

Frederick Albert Hills, 60, construction superintendent for the Anaconda Copper Mining Co., died in Butte on Oct. 6.

Josiah Bowden, 71, of Helena, Mont., died in that city on Sept. 12. He was for many years connected with the Longmaid mining interests.

Henry Peck Bardshar, 74, mining and metallurgical engineer, died in Los Angeles on Sept. 20. He was an alumnus of the Colorado School of Mines and had been active in his profession up to the time of his death.

C. Bai Lihme, 80, a retired metallurgist formerly prominent in the zinc and lead industries of the United States, died on Oct. 14 in New York City.

M. B. Dudley, who had been active as a mine owner and operator in Ari-

zona for past five years, died July 16.

Thomas Frank (Tommy) Lennan, mine operator in the Tri-State district for 47 years, died at his home in Joplin Sept. 10.

Peter S. Haury, mining engineer attached to the Tucson division of the U. S. Bureau of Mines, at the University of Arizona, died at Tucson on Oct. 11.

Walter Douglas, mining engineer, since 1890 associated prominently with metal-mining enterprises, died at Chauncey, N. Y., on Oct. 2, at the age of 75.

Hemming I. Franz, 43, general superintendent of the Eastern Magnesia Talc Co. at Waterbury, Vt., died on Aug. 27 last as a result of an accident in the company's No. 2 mine.

James E. Jopling, former chief mining engineer for Cleveland-Cliff Iron Co. and a pioneer in developing the iron deposits of the Upper Peninsula of Michigan, died recently at Marquette, Mich., at the age of 84.

An Appreciation of Walter Maynard Drury

The passing of Walter Maynard Drury on July 16 last at Santa Barbara, Calif., was a highly personal loss to many of the mining profession, particularly in Mexico. Those who were associated with him for 35 years, and who had the privilege of knowing him well, appreciated him not only as a brilliant engineer but as a stanch and loyal friend.

Mr. Drury was admired throughout the profession for his great abilities in handling the many intricate and difficult problems which came up for a quick decision. His vision and thorough understanding were really uncanny. His criticisms were always welcome, for they showed a profound understanding of the subject. He rose from an engineer to vice president of the mining department of the American Smelting & Refining Co.

After graduation from M.I.T. in 1903, Mr. Drury acquired experience as an underground miner in Butte, Mont., and the year following he became associated with the American Smelting & Refining Co. in Mexico. He devised and put into operation in 1908 the first surviving flotation plant in North America—that at the Tecolotes mill, at Santa Barbara, Chihuahua. He was then general superintendent of Minas Tecolotes y Anexas and his abilities as an executive capable of achieving low mining, transportation, and milling costs earned for him merited distinction and recognition. He became general manager of A.S.&R. mining interests in Mexico in 1912, and continued in that capacity until the day of his passing. He was made a vice president of the company in 1944. He had been a member of the A.I.M.E. for more than 40 years. A. W. EDELEN

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NEW BOOKS

THE REGULATION OF THE SECURITY MARKETS. By Willard G. Atkins, George W. Edwards, and Harold G. Moulton. Published by Brookings Institution, Washington, D. C. Pp. 126. Price $2.

This book is one of an integrated series of studies pertaining to post-war readjustments and reconstruction. Sponsored by the Brookings Institution, it needs no indorsement as to impartiality in its presentation and discussion of the controversial subject of security regulation.

In the preface it is stated that the present study seeks to clarify the basic issues involved and to analyze the forces and conditions responsible for federal regulation; to summarize in non-technical form the major purposes and provisions of the securities acts; and to discuss the practical issues arising out of the administration of these laws.

This is well done. The book has six chapters. The first four have to do with the general background of securities regulation, and how the demand for such regulation became insistent after the debacle of 1929. In the fifth chapter the various federal regulatory acts are briefly summarized from the original Securities Act of 1933 through the Investment Advisers Act of 1940. In the final chapter the issues are discussed under ten headings, with the authors' recommendations succinctly stated.

In a volume of this small size there is space for only a bare outline of the various laws, but the essential requirements are presented clearly in non-technical language. The average reader can gain a good over-all knowledge of what the various acts strive to accomplish; what must be avoided in preparing a prospectus or registration statement; and what must be set forth.

The authors emphasize it is too much to expect that investors can always be protected from their own impetuousness. To attempt to do so would involve controls not only inconsistent with the survival of private enterprise but so detailed and cumbersome that economic enterprise would be impoverished. Yet they agree that prospective investors shall be protected against fraud and that they shall be supplied with adequate information to arrive at an intelligent decision as to the risks they assume when they enter the capital market. To this, no reasonable man can take exception.

In recounting the history of security regulations, the authors come to the defense of maligned financiers of the '20's, and point out that it is unfair to attribute all the losses of the depression period to fraudulent or misleading information or manipulative practices without giving due weight to the inevitable losses due to cyclical economic fluctuations and speculative excesses in the commodity markets.

In discussing the issues involved in their criticism of the various securities acts, the authors are in full agreement that the government should not pass upon the soundness of security issues. This of course is stated in the original 1933 Securities Act, but at times it would appear that it has been more honored in the breach than in the observance by the administrators. As the authors remark, "The Commission was so bent upon protecting the public that in practice there was a tendency to prevent the flotation of securities whose ultimate soundness might be in doubt. By the protracted use of letters of deficiency and stop orders it was possible to prevent the flotation of securities where the risk element appeared large." Spokesmen of the mining industry have denounced this tendency of the SEC on many occasions.

Again the authors call for simplification of the registration statement, and quote approvingly from a report by the American Bar Association that the trouble and expense of preparing the statement and prospectus has been one of the major difficulties of the act, while the development of the prospectus into a document far too complex and unwieldy for its purpose has been one of the act's major failures. Another pertinent recommendation is that federal and state securities legislation should be coordinated, so that the state's requirements would be met by filing a copy of the registration statement under the SEC.

W. F. BOERICKE

TECHNICAL DICTIONARY, ENGLISH-FRENCH AND FRENCH-ENGLISH. By Francis Cusset. Chemical Publishing Co., 26 Court St., Brooklyn 2, N.Y. Pp. 591. Price $5.

To determine the real value of a foreign-language dictionary for oneself, one must make use of it for an adequate period of time. Selection of words for a glossary for any branch of technology requires a fairly detailed knowledge of that branch, as well as of both languages involved, if equivalent words and terms are to be properly paired and omission of important terms is to be avoided. In short, the preparation of a work covering metallurgy, mining, electricity, chemistry, mechanics, and "science," as Cusset's volume purports to do, is no easy task. This publisher avers that here it has been well performed, and a quick examination indicates that the book should be useful in reading French technical texts, although the compiler seems to be more familiar with coal mining and the steel industry, for example, than with metal mining. A spot test on our favorite examination word "stope," reveals only the inclusion of "stope raise (rill . . .)," which is defined as "cheminee d'evacuation des produits (mines)".

PUBLICATIONS RECEIVED

"Study of the Iron-Bearing Ore Deposits of Mexico" (in Spanish). Vol. 2, covering deposits of northern group, in the states of Chihuahua, Coahuila, Durango, Nuevo Leon, and Zacatecas. By Luis Toron Villegas and Adrian Esteve Torres. Published by the Bank of Mexico, Mexico City. Text pages, 147, including a large number of maps, tables, and geological plans and sections; also several hundred photographs on separate plates.

"Prevention of Explosives Accidents in Metal Mines." Metal-Mine Accident-Prevention Course — Section 4. U. S. Bureau of Mines, Miners' Circular 54. Pp. 80. For sale by the Superintendent of Documents, Washington 25, D. C.

"Fires, Gases, and Ventilation in Metal Mines." Metal-Mine Accident-Prevention Course, Section 5. Miners' Circular 55. For sale by the Superintendent of Documents, Washington 25, D. C. Pp. 94. Price 20c.

California Journal of Mines and Geology. Vol. 42, No. 1, January 1946, Division of Mines, Ferry Building, San Francisco, Calif. The principal subjects covered are "Geology of Santa Rosa Mountain Area, Riverside County, California," by L. B. Wright; "Geology and Nickel Mineralization of the Julian-Cuyamaca Area, San Diego County, Calif.," by S. C. Creasy; "Tin Deposits of the Gorman District, Kern County, Calif.," by John H. Wiese and Lincoln R. Page; and a transcript of "Relocation of Claim by Original Locator, State of California District Court of Appeal." Pp. 63. Price 60c., plus 2c. sales tax for purchasers from other states.

"Spectrochemical Analysis With the Oscillograph," by G. H. Dieke and H. M. Crosswhite. Also "Spectral Intensity Measurements With Phototubes and the Oscillograph," by G. H. Dieke, H. Y. Loh, and H. M. Crosswhite. Research Report W-193A, Project WPB-28. Office of Production Research and Development, War Production Board, Washington, D.C. Now released. Pp. 11, total, plus 13 plates.

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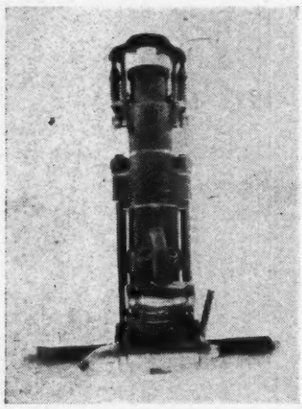
EQUIPMENT NEWS

Rugged Jackhammer

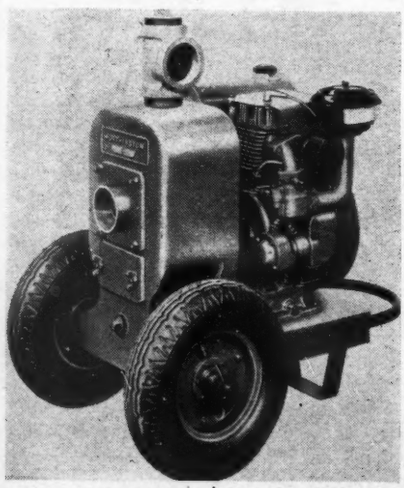
Schramm, Inc., West Chester, Pa., announces a new version of the company's D-45 rock drill, a jackhammer



made of drop forgings throughout, all parts of which are of special analysis steel heat-treated for their particular function. Making use of a new-type valve, which is patented, the action is said to be faster than that of any other valve. The drill, described in the company's bulletin, D-45, can be furnished in dry blower or wet types, and for ⅞- or 1-in. steel.

Portable Pumps

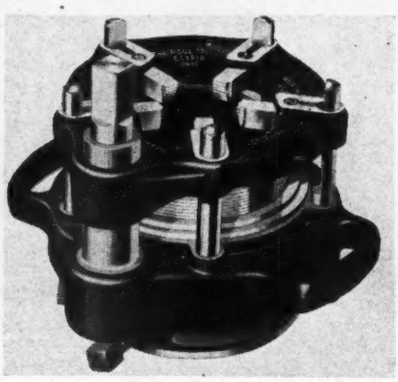
Self-priming action is the outstanding feature of the portable Blue Brute line of centrifugal pumps manufac-



tured by the Worthington Pump & Machinery Corporation, Harrison, N. J. These rugged units are available in 1½- to 4-in. sizes equipped with air-cooled gasoline engines; 6- to 8-in. units are equipped with water-cooled gasoline or diesel engines.

Quick-Acting Pipe Threader

By means of a new design, the 4P pipe threader recently announced by Ridge Tool Co., Elyria, Ohio, can be set exactly to size before being placed on the pipe. Once on the pipe, the threader is secured by tightening only one screw. Ease of handling has been increased by supplying two balanced loop handles on the gear case. The twin-anchored drive shaft turns in oil-less bronze bearings; the gear is fully inclosed and packed in grease.



INDUSTRIAL NOTES

Ralph R. Newquist has been elected vice president in charge of sales of Roots-Connersville Blower Corporation, Connersville, Ind.

R. G. Holmes, with the **Denver Rock Drill Mfg. Co.** since 1911, retired on Aug. 1 from his position as Vancouver district manager for Gardner-Denver Co.

M. N. Shaw was recently appointed chief metallurgist for U. S. **Vanadium** Corporation. He is at Henderson, Nev.

John I. Duffey, in Brazil for Metals Reserve Co. for the last three years, has returned to the United States and may be addressed at 925 Floreho St., Tucson, Ariz.

J. B. Knaebel, 1666 Forest Hills Drive, Salt Lake City, Utah, has resigned from United States Smelting, Refining & Mining Company.

B. V. E. Nordberg, executive engineer, and son of **Dr. Bruno V. Nordberg**, founder of Nordberg Mfg. Co., died on Aug. 19 at the age of 62. With the Nordberg company since 1907, Mr. Nordberg also took an active interest in several engineering societies and educational institutions. In civic affairs he had served as a member of the Milwaukee Sewerage Commission continuously since 1926. He was vice chairman of the Wisconsin Registration Board of Architects and Engineers, Regent of the Milwaukee School of Engineering, and member of the Advisory Board of Marquette University.

Gerald Thorp, vice president of Bethlehem Foundry & Machine Co., Bethlehem, Pa., died on Aug. 22.

Wyandotte Chemical Corp. has appointed Charles O. Chesnut general manager of the newly organized Pacific division. Manufacturing and distributing activities in the Pacific States of the products of both the J. B. Ford and Michigan Alkali divisions of Wyandotte Cehemical Corp., and of Natural Soda Products Co., now will be directed from the new Pacific division office, 502-14 Central Power Bldg., San Francisco, Calif.

Triangle Package Machinery Co., Chicago, has purchased the Rapp Mfg. Co., Los Angeles, formerly its West Coast associate. Both physical assets and business changed ownership. Factory operation in Los Angeles will continue under the Triangle Package Machinery Co. name.

A. E. Anderson has retired as manager of the Seattle office of the explosives department of **E. I. duPont de Nemours & Co.** He is succeeded by **R. F. Cramer. S. M. Strohecker, Jr.**, is assistant manager of the Seattle office.

BULLETINS

Tractors. A 32-page catalog on the HD-14 diesel tractor has been released by the Allis-Chalmers Tractor Division, Box 512, Milwaukee 1, Wis., showing the tractor in action, and cutaway views of important parts. Allied equipment, auxiliary attachments, and specifications are also included.

Core Splitter. Canadian Longyear, Limited, North Bay, Ont., in Bulletin 46 describes an improved core splitter having a capacity of 70,000 lb. pressure, sufficient for splitting core of any kind of rock.

Clamshell Buckets. Advantages of modern all-welded construction in the design of clamshell buckets are analyzed in a new eight-page booklet by the C. S. Johnson Co., Koehring subsidiary, Champaign, Ill.

Screens. The unique three-component elliptical motion applied to Robins Eliptex screens is described in bulletin No. 111-A, recently released by Robins Conveyors Inc., Passaic, N. J. Special uses, as in Heavy-Media plants, are described in detail.

Mechanically Set Bortz Bits. Bulletin 63, E. J. Longyear Co., Minneapolis, Minn. Covers core bits, casing bits, reaming bits, and shells in all standard sizes.

Spiral Concentrator. Principles of operation, performance data, operating costs, pilot-plant procedure and designs, and testing techniques for the Humphreys Spiral concentrator are described in Bulletin 5, issued by the Humphreys Investment Co., First National Bank Bldg., Denver 2, Colo.

Engineering Services. E. J. Longyear Co., Minneapolis, Minn. Bulletin 68 covers the company's activities, including manufacture of diamond core drills and core drill supplies; also engineering services, including contract core drilling, contract shaft sinking and mine development, mine examinations and reports, and geological investigations.

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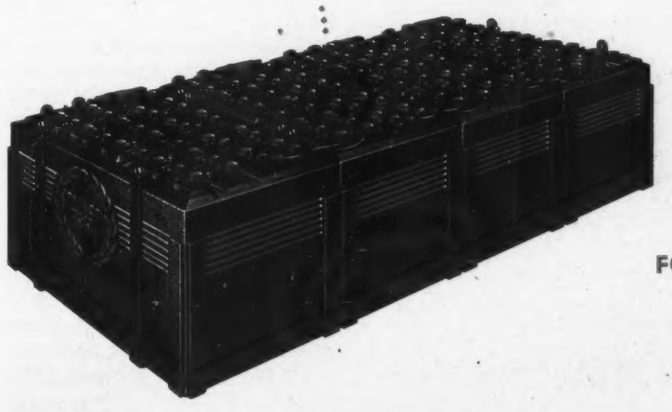

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REGIONAL NEWS

COLORADO

Empire Lee mine, at Cripple Creek, reopened—Silver Bell, at Ophir, producing.

★Golden Cycle Corporation has announced plans to enlarge and improve the Cameron mill, in Cripple Creek, and put it into operation to mill low-grade Cripple Creek ores without transporting them in bulk to the Golden Cycle mill, in Colorado Springs. According to A. H. Bebee, vice president and general manager of Golden Cycle, the corporation has carried on considerable research in working out an economical process for milling lower-grade ores. Milling such ores near the properties where they are mined will eliminate thousands of tons of transport monthly to Colorado Springs. The Cameron and Pinnacle properties, on which the mill is located, were bought about three years ago by Golden Cycle. The mill was built about 10 years ago and was operated until 1942, when it was shut down as a result of Order L-208.

★El Paso Mines, Inc., has acquired some 200 acres surrounding the El Paso mine, halfway between Victor and Cripple Creek, and is developing the property, closed since 1942. Seven sets of contractors are busy on several levels of the mine. A new cage has been installed in the shaft, new ore cars have been received, and the levels are being put in condition for storage-battery haulage. About 40 men are employed. The dump or surface has been leveled for parking space and storage, and buildings have been rehabilitated. Officers of El Paso Mines, Inc., are George A. Easley, of New York, president; Harvey L. Tedrow, of Denver and Cripple Creek, vice president and general manager; James S. Worth, of New York, vice president; and Henry C. Hoffman, New York, secretary and treasurer. The company purchased the El Paso from Thomas A. Copeland and James A. Knight, of Chicago.

★The Empire Lee mine has been reopened at Cripple Creek. Empire Leasing Co., composed of Robert Gregg, of Cripple Creek; Harold Berndt, and R. G. Polson, of Wichita, Kan., has leased the property from the Empire Lee Mining Co., a United Gold Mines subsidiary. The mine is open for split-check leasing, and leases will be held for those who had them prior to the shutdown in 1942. Company development work is planned later. Another mine recently reopened is Gold King, which has been closed down about eight years, according to H. A. Mollineux, of Syracuse, N. Y., a representative of the owners. Vic Porter is in charge. The mine will be operated for split-check lessees.

★John W. Snyder, Secretary of the Treasury, has accepted an invitation to speak at the golden anniversary annual convention of the Colorado Mining Association, Feb. 6, 7, and 8, in Denver. All Western universities are being asked to send representatives to a conference on the part played by gold and silver in monetary systems of the world. This, said Secretary Robert S. Palmer, is designed to combat the influence of Eastern universities and economists who resist higher prices for silver. The Executive Committee of the Association has decided to survey the premium-price plan for metals, looking toward recommendations as to whether it should be continued after July 1, 1947, present date of discontinuance of premiums on copper, lead, and zinc.

★Production at the Silver Bell mine, at Ophir, has been started, and the M. & W. Mining Co. is operating the Charles Williams property, on South Mineral Creek near Silverton. The Silver Bell improvements include a new 150-ton flotation mill. Mine and mill are electrically powered throughout. A diamond-drilling program has been started and development work is being carried on at several levels. The ore contains gold, silver, lead, and copper.

M. & W. Mining Co., which is operating the South Mineral Creek under lease, is composed of Junior Morris, of Durango, and J. W. Whisnant, of Denver.

★The Red Elephant mine, at Lawson, has resumed production after being shut down during the war. Plans call for a crosscut about 1,900 ft. from the portal, to pick up the Tabor and St. James veins. Charles Hull, of Idaho Springs, is superintendent. The mine is financed by Chicago capital.

★The Malachite mine, on Genesee Mountain, being operated by R. M. Moore, of Colorado Springs, and G. G. Gowan, of Fort Worth, Tex., is producing copper ore. It is being treated at the Black Eagle mill, at Idaho Springs, at the rate of about 100 tons daily.

★Four young war veterans, members of the Colburn family of Denver, are reopening the Sporting Times, a family property near Georgetown. They are Cyrus L., 25; William A., 23; Thomas L., 21; and Patrick, Jr., 19. William will graduate from Colorado School of Mines in June. The boys have been working all summer to clear the main adit and restore the mine. It is a gold and silver producer.

★Joy Mfg. Co., of Michigan City, is carrying out the diamond-drilling program instituted on the St. Theresa property, on Trout Creek Pass, in Chaffee County. Earl J. Hayes, of the Joy company, is foreman in charge of drilling, and the mine is in charge of John F. Klaes, of San Francisco. Principal owner is Howard Crandall, of Denver.

★The Mollie Gibson, on Smuggler Mountain near Aspen, is being operated by Bill, Lawrence, and John Herron after they have spent some years working mine dumps on the Aspen district. Their mill, completed in 1943, is at the Mollie Gibson. After exhausting dump possibilities the brothers began prospecting in the mine and have discovered, they say, a good silver vein running parallel to the main tunnel.

★Warwick Mining Co. is operating the Murray property, in Smith Gulch about 25 miles from Canon City. The ore contains lead, zinc, copper, silver, and gold, and is being shipped to the A.S.&R. mill at Leadville. T. H. Sackett is president and Judge Joseph Blunt is secretary and treasurer.

UTAH

Safety record improves—Drop in insurance paid for compensation—Future studied

★Two officers of the Tri-State Zinc & Lead Producers' Association conferred in Salt Lake City Oct. 11 and 12 with Utah mine operators on means of maintaining metal production after the premium price plan expired next June. O. W Bilharz, association president and manager of Bilharz Mining Co., said it is assumed that OPA will go out next year and the metal price plan is a part of that act. The Tri-State district now is producing close to capacity but could not continue to do so under any free, competitive price system that could be anticipated reasonably with the ending of price ceilings and premium prices. If the mines are permitted to close, they cannot be reopened except at a prohibitive cost, he said, which could mean permanent loss by that district of pro-

(*Continued on page* 100)

Ontario Committees Report

(*Continued from page 77*)

and overwind in Ontario mines is generally provided.

Electrical braking systems are recommended as a subject for study by mine operators from the standpoint of rope life prolongation. Decelerations applied electrically are less severe.

With the cooperation of the Ontario Department of Mines and the special committee of the Ontario Mining Association a record of the behavior of cage safety dogs in all instances involving accidents to conveyances thus equipped in Ontario mines was compiled. Of the 28 well-documented cases, 18 represented effective stopping.

Experimental data covering the behavior of cage safety devices were made available by Ontario mines which conducted 116 drop tests of cages with initial velocity. The safety dogs failed to act satisfactorily in 14 of the tests.

The apparent causes of the 14 failures were as follows: in five instances the dogs turned over because of inadequate stops; in three, the dog teeth became clogged with wood spoil; in two, a guide buckled; in two, the guides or joints were faulty; in one, the dog teeth were too short; in one, the rope drag, or trailing rope effect, prevented the springs from actuating the dogs.

The conclusions and recommendations of the Ontario Mining Association committee, appended to the main report, in general substantiate the latter. The report notes that most Ontario hoisting accidents are due to rope failure caused by corrosion and wear of the ropes, and occur most frequently when the conveyance is ascending. Safety dogs are more likely to function successfully when the cage is ascending. Poor design of safety dogs accounts for many cases of malfunction, but for descending conveyances a long section of trailing rope prevents proper dog action. The ideal safety dog for general use, not yet determined, should arrest a falling conveyance at a deceleration not over 2g.

It is recommended that the restrictions placed on the retention of hoisting ropes in service be expanded. Approval of future hoisting installations should take into account that maximum safe life of hoisting ropes is obtained where the ratio of drum or sheave diameter is at least 85 to 1 and the fatigue stress of the installation is not more than 25 percent of the ultimate strength of the rope.

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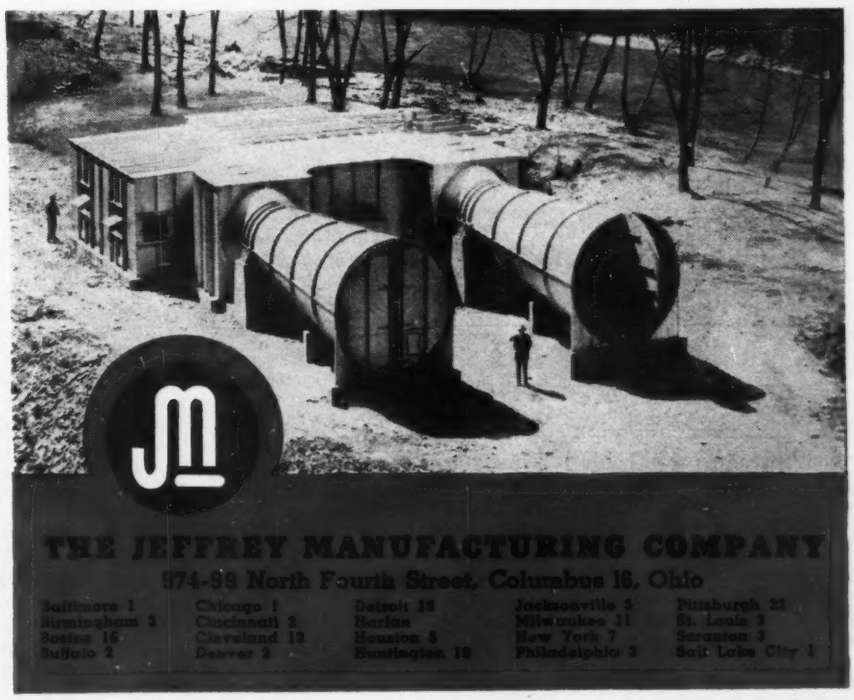

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Utah (*continued*)

duction which amounts now to 26 percent of the domestic zinc output and 8 percent of domestic lead.

H. A. Gray, vice president of the association and vice president of Eagle-Picher Mining & Smelting Co., was with Mr. Bilharz. The two went next to Butte and planned to go to northern Idaho next, and also to the Michigan copper district. They had discussed the situation with Arizona producers.

★Fatal accidents in Utah's non-ferrous metal mining industry totaled 24 for the 1944-46 biennium compared with 30 for the previous two-year period. R. H. Dalrymple, safety commissioner, said that though no safety record is good enough until it is perfect, "we feel that operators and employees of the metal-mining industry should be congratulated for the excellent record they have achieved."

The report shows that insurance payments charged all Utah employers for workmen's compensation have declined 65 percent since Jan. 1, 1943.

★Potentially important mineral production in western Utah would be blocked by a proposed withdrawal of an additional 3,034,000 acres of public lands there for use as a rocket-testing range, it was testified at a public hearing conducted on Sept. 12 and 13 in Salt Lake City. Considerable vanadium ore, in the Drum Mountain area, and fluorspar, near Milford, were produced during the war. C. Girard Davidson, Assistant Secretary of the Interior, who conducted the hearing, said a report on the proposed withdrawal would be made shortly.

★The Interstate Commerce Commission has authorized the Denver & Rio Grande Western Railroad to abandon 24 miles of track extending from the cement quarry in Parley's Canyon to Park City; also to abandon operation of the 2¾-mile Ontario branch in the Park City area, the latter to be taken over and operated by the Union Pacific Railroad. The Utah Mining Association did not oppose the abandonment, so long as this does not result in increased freight rates to the area.

MONTANA

Manpower situation at Butte is improving — Golden Messenger develops Crystal properties

★Quartz Hill Mining Co., which owns silver properties in the Vipond mining district, 12 miles southwest of Divide, Beaverhead County, has called a special meeting of its stockholders for Oct. 15, to consider giving a lease on the property to Nelson & Irving. Selden S. Rodgers, of Anaconda, is vice president and general manager.

★Domestic Manganese & Development Co., of Butte, has been named as agent for the Reconstruction Finance Corporation, to operate as a custom mill in the concentration of lead ores. This action was taken at the direction of the Civilian Production Administration in view of a serious lead shortage. The mill, which uses a flotation process, treated manganese ores during the war. It has a capacity of 400 tons of ore per day. John H. Cole, of Butte, is president of the Domestic M.&D. Co.

★H. G. Satterthwaite, assistant general superintendent of the Anaconda Copper Mining Co.'s reduction plant at Great Falls, gave an address on "Magnesium" before the Butte Rotary Club on Aug. 29. Mr. Satterthwaite was superintendent of the plant of Basic Magnesium, Inc., at Las Vegas, Nev., which produced more than 25 percent of the total production of magnesium in the United States during the war. Anaconda Copper Mining Co. during the war supervised all operations at the Las Vegas plant under a management agreement with the U. S. Government.

★George Spehn has sold his entire interest in the Neihart Mining & Milling Co., at Neihart, Cascade County, to L. E. Taylor, who already owned a large interest in the company. Frank Stagg also purchased an interest in this company. Mr. Spehn has bought a large interest in the Bennett Mining Co., at Neihart, and is manager of that company. He reports that a large body of lead-zinc-silver ore has been encountered at the Bennett mine after drifting 100 ft. through a hard fault.

★Golden Messenger Corporation, after closing down its gold properties at York, Lewis and Clark County, in 1942, purchased the properties of the Crystal Mines at Basin, Jefferson County, and at Butte. The company has just unwatered the old St. Lawrence shaft near Basin and is driving a crosscut tunnel west from the Crystal claim, to tap the St. Lawrence shaft at a depth of 400 ft. Several winzes have been sunk from the tunnel. The ore contains lead, zinc, copper, silver, and gold. Substantial shipments have been made in the past. W. S. Norman, of Spokane, is president and manager of the company; W. L. Bell, of Spokane, is consulting engineer; and Charles R. Brazier, of Helena, is secretary and Montana agent.

★Although the local labor supply is somewhat improved, many additional men will be needed to restore district operations to normal, according to officials of the Anaconda Copper Mining Co. at Butte. Capacity operations of copper and zinc mines will require 3,000 additional miners, it is estimated. The company is reopening the Mountain View mine. When the normal working force of 350 to 400 men has been filled at this operation, production will be resumed at other mines as the available labor supply permits.

★Since June 1, the Green Mountain mine, at Dixon, has been shipping crude ore and concentrates to the Anaconda smelter at the rate of two cars per month, netting a return of approximately $5,000 a car.

IDAHO

Lucky Friday opens good ore on 1,400-ft. level — Shaft work resumed at Highland-Aurora

★Polaris Mining Co. has added the Merger Mines property to the group of mining claims in the silver belt west of Wallace, to be developed by the 3,000-ft. Silver Summit shaft now nearing completion by Polaris. In addition to the original Polaris holdings, this group now includes the mining property owned by the Chester, Silver Summit, Yakima-Shoshone, and Merger companies. Polaris owns the control of Chester and Silver Summit and holds the other two under a 50-50 profit-sharing agreement.

★Coeur d'Alene Mines Corporation has issued a circular letter advising its stockholders that "since the commencement of shaft sinking about May 1 the shaft has been extended a distance of approximately 420 ft., which almost completes the present sinking program. We plan an additional 20 or 25 ft. to provide ample depth for the skip pocket and sump below the 2,800-ft. level. Little ore has been mined during the past four months but since the increase in the price of silver we have started work in sections of the mine where there is ore which, at the higher price (for silver), should pay at least part of our maintenance and development expenses." The letter also advises that the directors have levied an assessment of 2c. per share, payable Oct. 9 and delinquent on Nov. 9, 1946.

★Lucky Friday Silver-Lead Mining Co. has recently completed its shaft development to the 1,400-ft. level and has successfully opened its rich vein system in a crosscut from the bottom of the shaft on that level. Up to Oct. 1 the company had opened a minable orebody for a distance 150 ft. in length with a full face of ore in both east and west headings. Hand samples of the ore assay from 147 to 194 oz. silver, 19 to 45 percent lead, and 19 to 23 percent zinc per ton. About 1,500 tons of the ore from the drift work is being stockpiled for mill treatment.

In development work down to the

Idaho (*continued*)

1,000 level the company shipped $206,531.79 worth of ore, paying its own original purchase price and all operating and equipment cost without expense to the stockholders.

★American Smelting & Refining Co. has resumed shaft sinking at the Highland-Aurora property, in the Beaver district, north of Wallace. The shaft had been completed to the 575-ft. level when work was suspended because of labor shortage. It will be continued to the 1,000 level before crosscutting to the vein system is undertaken. The work is under the management of the Federal Mining & Smelting Co. Twelve men are employed in the shaft work.

★Crescent Pacific Mining Co. is operating an unusual type of gold dredge on the Salmon River near Lucile, where the company has obtained a lease from the State on 14 miles of the river bed. Instead of digging buckets the dredge uses a suction device to bring the gold-bearing sands into the boat. The operation is described by Walter Hovey Hill, mining engineer of Grangeville, Idaho, as follows:

"Operation is by remote control, and one man per shift can operate the plant. The equipment includes a pumper dredge, using the Becker-Hopkins patent for the digging head and radius arm. The boat is of the pontoon type, with all-steel construction, having an over-all length of 52 ft. and width of 20 ft. plus the outriggers on the outside of the hull, which are 28 ft. long. The dredge has a draft of 20 in. and weighs 60 tons. The operation is Diesel powered.

"The digging head, which is the point on a hollow shaft, is 8 in. in diameter, built of high test steel, and has 24 holes or openings just above the point, each 2 in. in diameter.

"As the point is lowered vertically into the bed of the stream it penetrates the gravel, revolving at a speed of twelve revolutions per minute, and as this goes down all the fine gravel and material that will enter these openings is forced up like a core to where an 8-in. suction hose is attached to the tube or shaft, and then the pump sucks it up 20 ft. to a box containing a screen. All the gravel is washed in the pump and in the suction and discharge pipe. From the hopper the screen discards all the material that does not pass ¾-in. slots into a conveyor belt in the center of the boat, whence it is discharged off the tail of the conveyor at the rear end of the boat.

"The fines that drop through this ¾-in. slot go into the distribution system of the 24 ⅜-in. sluice boxes on each side of the boat that are lined with cocoa-matting riffles and other standard forms of gold-saving tables. The total sluice box service is 24 by 32 ft. At the tail sluice, where the material goes overboard, is another slit screen through which the fines drop

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Idaho *(continued)*

into an Ailney bowl that catches some of the very fine gold and is used as a clean-up pan. Most of the gold recovered in this testing operation is coarse.

★The mining of phosphate rock is increasing in Idaho, according to engineers. Rock phosphate is mined at Soda Springs and Montpelier by the San Francisco Chemical Co. and the Anaconda Copper Mining Co., and is shipped in mine-run form to the Anaconda smelter at Anaconda, Mont., and the Simplot fertilizer plant at Pocatello, Idaho, for processing into fertilizer. The Simplot plant is now producing 120,000 tons annually. The product is said to have increased farm production, where used, by 20 percent.

★Liberal King Mining Co., whose property on Pine Creek is under lease and option to the Sunset Minerals Co., has declared a dividend of 1½c. per share, totaling $25,500, from royalties received on ore produced by the purchasing company. The secretary of Liberal King, H. J. Hull, says the dividend is in the nature of a return of capital invested, as the money is to apply on the purchase price of the property. The Sunset Minerals Co. is mining a vein of complicated zinc and lead ore difficult to separate, requiring grinding down to 200 mesh. The ore deposit is a "blind" vein discovered on the 1,000-ft. level, where mining operations have developed an orebody 1,000 ft. in length and from 4 to 12 ft. wide. During the first quarter of 1946 Sunset Minerals shipped 190 tons of lead concentrates and 530 tons of zinc concentrates, which gave gross returns of $79,629.19. The company has a milling plant of 100 tons' daily capacity.

★New Hilarity Mining Co., which recently started a deep tunnel to develop the Wolverine and Paramount properties in the silver belt between the Bunker Hill and Sunshine mines, reports that the tunnel has cut the Paramount vein in a well-mineralized section but found no ore in commercial quantity at the depth attained. The tunnel will be continued 1,000 ft. to the Wolverine vein, which will be opened at much greater depth.

★Polaris is the first mining company in the Coeur d'Alene district to try out a mechanical mucking machine in shaft-sinking operations. The machine is in use in the company's Silver Summit shaft and is a clamshell bucket device developed by the E. J. Longyear Co., of Minneapolis. During its first trials the machine developed a number of "bugs", but when these defects were corrected the shaft crew put the three-compartment shaft down 184 ft. in 30 days.

George Grismer, superintendent of the Polaris shaft operations, recently explained the operation of the machine before the metal mining convention in Denver. The mechanism

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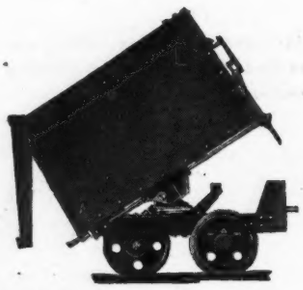
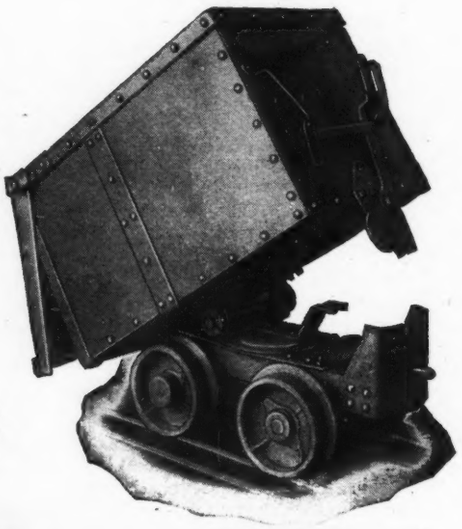
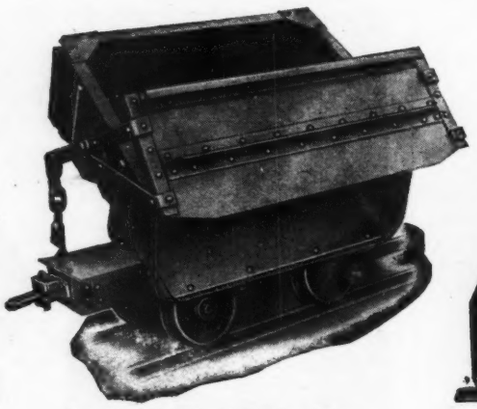


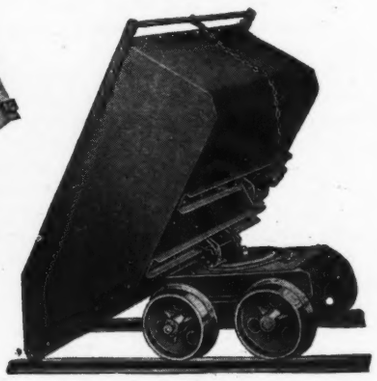
(*Above*) Patented box dump car with improved rotating and dumping device.



(*Right*) Standard 3-way dump ore cars for tipping to one end or either side.



Low height Granby Type Car—30 cubic feet capacity.



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Idaho (*Continued*)

of the mucking machine, he said, consists of three parts, the steel frame, a carriage, and the clamshell bucket with a holding capacity of ⅜ cu. yd. for each bite into the muck pile. The carriage moves horizontally along the long axis of the shaft. Mounted on the carriage are three air-driven motors, two single-drum units to operate the clamshell bucket—one serving the digging line and the other the hoisting line—and the third unit to move the carriage by means of chain drive and sprocket wheels.

Two men ride the carriage, one operating the clamshell and the other moving the carriage and the bell signal line to the hoisting engineer. The frame and carriage can be lowered to a new working level in twelve minutes, Grismer reported. The frame is held in the shaft by four hanging rods which are bolted to U-shaped hangers which straddle the end pieces of the shaft sets. When the frame and carriage are to be lowered they are raised sufficiently by the shaft hoist to permit the hangers to be disengaged. Then they are lowered, and the hangers are placed and secured by safety devices. Work is then ready to be resumed.

The company is using the bench method in sinking the shaft, which is 9x18 ft. in untimbered dimensions. Each bench round requires 36 holes and the drilling time requires from two to two and one-half hours. One hour is required after blasting to clear the shaft of smoke and gas. It requires about three hours to muck out one bench round, averaging about 30 buckets of 30-cu. ft. capacity. Hoisting is accomplished with a 250-hp. double-drum electric hoist with a rope speed of 800 ft. per minute.

WASHINGTON

Prospector's course offered by U. of Washington — Glacier gets Ambassador mine

★Jay Dee mine, near Chewelah, will sink its shaft to the 200-ft. level and crosscut to the ore, according to B. Stuart, president. The shaft had reached the 160-ft. level when work was stopped before the war.

★Silver in busbars loaned by the U. S. Treasury to the aluminum and magnesium plants at Spokane, when it was impossible to secure copper, started leaving Spokane Oct. 4 for the Denver Mint. The bars are heavily guarded 24 hours a day.

★Interest in the Royal Development Co.'s copper property, 40 miles north of Leavenworth, has been revived by the conclusion of litigation over distribution of assets. It is proposed to authorize a receiver to sell the property. A 500-ton mill was built and the mine was opened by a 2,000-ft. tunnel years ago. The company's head office is now at Hornell, N. Y.

★Eighteen men are employed by the Talisman Co., near Laurier, where a 150-ton mill is in production. John Sims is general manager and Les Gourlie mill foreman. Two crosscuts, one 600 ft. long and the other 200 ft., have cut the main vein, reported to be in an ore zone about 30 ft. wide and extending through three claims.

★According to John R. Meek, works manager for the aluminum rolling mill at Trentwood, orders are being booked for delivery in December 1947. Fifty percent of the output goes to West Coast points, including Spokane industrial plants. Lewis Tompkins, industrial relations director, said the employment rate is not sufficient to meet the new demands. In September 14,500,000 lb. of aluminum sheet was produced, exceeding the quota by about 2,500,000 lb. Six hundred men were needed for October.

★Dean Milnor Roberts of the University of Washington has announced that a prospectors' course will be offered in the fall, winter, and spring quarters of the 1946-47 school year. High school graduates may take the work without examinations and veterans may take it under the GI Bill of Rights. It will include field trips to metallurgical plants, to mines, and to areas for studying the geology and minerals.

★Adventure Mineral Corporation, capitalized at $100,000, has been incorporated in Washington by A. J. Champagne and Betty Lou Champagne, of Spokane, and George Geise, of Grand Coulee. The company will engage in placer mining.

★Glacier Silver Lead Mining Co., of Spokane, has acquired the Ambassador mine, consisting of 20 lode claims, in Sanders County, Mont., for 200,000 shares of the Glacier's Class A nonassessable stock. The mine is under bond and lease to John A. Walker for $100,000, this to be paid in royalties from smelter returns when shipments begin. A small crew has started work extending the tunnel. The Glacier company is also negotiating for the Leona Group of 5 patented claims and one location claim in Boundary County, in northern Idaho. At a recent meeting of the Board an assessment of ½c. a share was levied upon capital stock, according to a report to stockholders by F. W. Kiesling, of Spokane, secretary-treasurer. Charles J. Weller, of Coulee City, is president, and H. E. Majer, of Spokane, vice president.

★Ground under lease from Cold Bond Mining Co. is being worked by Karl Fackler and Walter Suckling, near Blewett, Wash. Two shipments of gold ore have been made to the Tacoma smelter since work began this fall.

★According to reports in Spokane, four groups are interested in acquiring the $16,000,000 magnesium plant operated during the war by the Electro-Metallurgical Co. This company is said to be interested and has until Dec. 17 to match any bid for sale or lease.

★The Metaline zinc mining district is receiving much attention. The American Zinc, United States Smelting, Freeport Sulphur, Hecla, Pend Oreille, and Metaline Mining & Leasing companies all are operating in the field. Production thus far has come only from the Washington side of the line, but the district extends into British Columbia, where the Reeves-MacDonald mine is reported to have 2,000,000 tons of zinc ore blocked out. Hecla's holdings are also in British Columbia at the Red Bird mine, about 17 miles northwest of Metaline Falls. The Geological Survey and the Bureau of Mines have done extensive diamond drilling in the region.

CALIFORNIA

State Mines Division increases its library service — Argonaut's Empire mine active

★Associated Metals, Inc., has installed a 50-ton flotation plant at the Oro gold mine, near Downieville, Sierra County, after doing extensive development underground for almost a year. The company plans to install a leaching plant, and is diamond-drilling in its Pine Grove mine, in Amador County. Ten men are employed. James Bonner is superintendent and Ira Mahon manager of the company's operations.

★A small crew is doing development work in the Empire mine, at Plymouth, Amador County, owned by Argonaut Mining Co. The mine was shut down by the L-208 closing order in 1942. Alex Ross, with headquarters at Jackson, is general superintendent of operations.

★Operations at the Italian gold mine, near Drytown, Amador County, are centered in deepening the main shaft. An underground hoist and compressor were recently installed and surface buildings have been erected. The 75-ton flotation plant is to be moved to a new location to eliminate tramming of the ore and its capacity is to be enlarged. The property is operated by G. L. Gaskell, president of Colorado Zinc Co., and H. G. Schweiger.

★Directors of Central Eureka Mining Co. recently levied another assessment of 15c. a share on capital stock. This brings the total to 45c., which has been raised to carry on the company's rehabilitation program at the old Central Eureka gold mine, at Sutter Creek, Amador County. C. C. Prior is president.

★The California Division of Mines,

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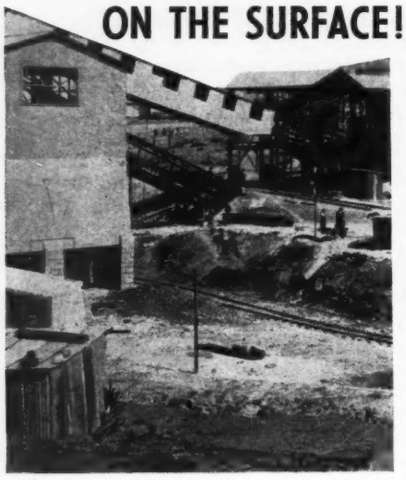

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California (*continued*)

W. B. Tucker, State Mineralogist, has increased its library services and has recently appointed Roy Nielsen to the post of librarian. Its library is considered to have one of the best collections of its type in the Bay area.

★According to the California Division of Mines, 9,628 long tons of chromite averaging 45.73 percent Cr_2O_3 was shipped from 30 mines in 10 counties in the state during 1945. The California miner received an average of $44.81 a long ton for this chromite, compared with $41.32 in 1944; $40.44 in 1943; and $36.64 in 1942.

★Shipments of manganese ore during 1945 came from 12 properties in 10 counties in the state and amounted to 1,621 long tons, of an average grade of 52.05 percent manganese. The average price received by California miners of ore shipped in 1945 was $53.22 a long ton f.o.b. mine, compared with $32.02 in 1944; $30.46 in 1943; and $23.10 in 1942.

NEVADA

Southern shipments tied up by closing of T. & G. to freight—Deep drilling at Tuscarora

★Eureka Corporation, Ltd., subsidiary of Ventures, Ltd., is halfway to its objective of 2,500 to 2,800 ft. in sinking its four-compartment shaft at Ruby Hill, near Eureka, which is being put down to develop some lead-silver-zinc-gold orebodies disclosed by deep drilling. George Mitchell is directing engineer for Ventures, Ltd. The project is said to be the most ambitious to be undertaken in Nevada since the early 70's.

★Standard Cyaniding Co., closed down by Order L-208 and prior thereto treating upwards of 700 tons per day of open-cut gold ore running $2.20 per ton, resumed milling in October on a 500-ton basis. This had been delayed for three months by inability to obtain equipment. Equipment which has been released at the request of federal agencies for an aggregate return of $20,000 was replaced at a cost of around $80,000, to which was added $25,000 for new labor-saving and safety devices. The project is headed and managed by Harold L. Hazen.

★Activities of Newmont Mining Corporation at Goldfield, through its subsidiary Esmeralda Operation, are being expanded. Newmont, it is said, has taken over the long-idle properties of Goldfield Deep Mines Co., embracing a major part of the southern district area. Newmont is said to have acquired several hundred lode claims in the district and to have purchased various town lots and buildings.

★Getchell Mine, Inc., continues sinking its new three-compartment shaft at a point 3,000 ft. north of old workings where deep drilling revealed orebodies of important dimensions and with small arsenic content. A crosscut is being driven to the ore zone on the 300-ft. level, 600 ft. below the apex, and surveys indicate the ore will be cut in the shaft at 1,200 ft. Capacity of the cyanide mill has been increased from 1,000 to 1,500 tons per day, and equipment of the 600-ton scheelite concentrator has been removed. Roy A. Hardy, of Reno, is directing engineer.

★Deep drilling is in progress at several points in the Tuscarora gold-silver district in Elko County, nearly all of the lode and placer areas that were productive up to the early 90's having been acquired under lease and option by the Utah Construction Co.

★Jumbo gold mine, owned by George Austin at Awakening, is to be equipped with a 500-ton mill.

★Southern Nevada mining centers have been deprived of a rail outlet with the closing to freight traffic of the Tonopah & Goldfield Railroad, extending from the Southern Pacific terminal at Mina, 85 miles to Goldfield, with a spur to Tonopah. The action, still under examination by federal and state boards, will virtually end all leasing activities in the region until local mills are provided to handle custom ore. The road was purchased just before the war from the Tonopah Mining Co. by the Dulien Steel Products Co., of Seattle.

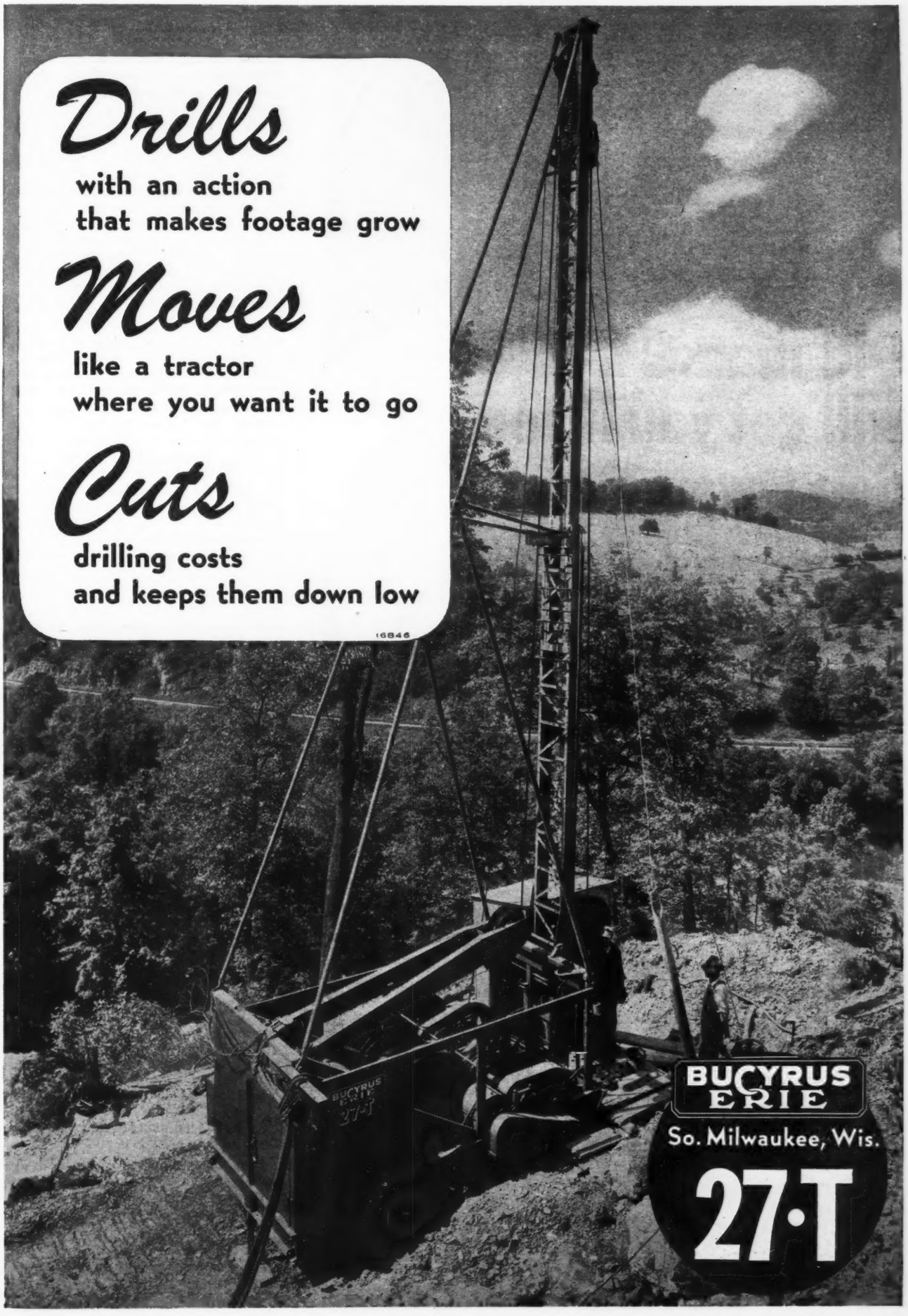
ARIZONA

Federal land return to state opposed by mining industry—Magma plans for San Manuel

★Arizona's State Department of Mineral Resources has disclosed that Arizona's mining industry is much involved in the movement to return federal lands to the state and will oppose such transfer unless certain rights now held are guaranteed. According to Charles H. Dunning, department director, most of the land is directly under federal control and the State Land Department and the cattlemen have been trying to have it returned to the state. The mining interests oppose such return unless they are granted the rights to locate, operate, and patent that they now enjoy on public domain.

Mr. Dunning explained that a miner, under the Arizona enabling act, cannot acquire final title to state land, but may only lease it on rental or royalty basis. He asserted that royalties are obsolete in modern low-grade, big-volume mining.

★The Department's annual report announces that $120,000,000 worth of metals was mined in Arizona in 1945, despite the shortage of labor and materials. Copper, with 571,000,000 lb.,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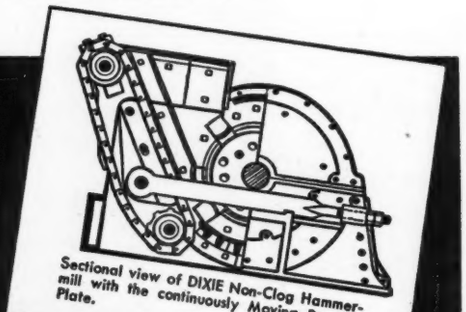

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Arizona (*Continued*)

led the metals. Lead amounted to 41,500,000 lb.; zinc, 76,500,000 lb.; silver, 3,357,000 oz.; and gold, 75,000 oz. The mining industry in the state pays nearly three times as much in taxes as agriculture and other industries. The report warned that new mines must be discovered to take the place of those becoming worked out. There has been as yet no resumption of gold mining in the state. Arizona had more than 900 small gold producers before the war. Production of minor metals —quicksilver, manganese, tungsten, molybdenum, and others—practically ceased after the war when the stimulus was removed.

★Plans to rush development of a copper deposit estimated to contain more than 100,000,000 tons of ore near Tiger, Pinal County, 45 miles northeast of Tucson, have been announced by Magma Copper Co., following action by the stockholders authorizing an increase in capital stock from 410,000 to 1,200,000 shares, a $10 par value. Proceeds of the sale of the new stock will be used to finance the San Manuel Copper Corporation, a subsidiary, which has been drilling on the deposit mentioned for months.

★Holdings of Great Western Mines, at Courtland, 30 miles north of Douglas, and including 23 patented claims, have been leased with option to purchase to Southwestern Mines, Inc. Rehabilitation has begun. Vincent Riccardi, owner, announces that offices will be opened in Douglas.

★Stockholders have approved sale of the Van Dyke Copper Co. to Anaconda for $5,000,000 under a lease-and-option-to-purchase agreement. Anaconda has made no announcement as to its plans for the property.

★Shattuck Denn is shipping three cars of ore daily from its property in the Dragoon Mountains to its loading point at Tombstone.

★Approximately $200,000 was paid by Phelps Dodge Corporation as retroactive pay to men at the company's New Cornelia mine.

★Mines in Arizona employed 11,300 persons in July, compared to 8,100 in June. Manufacturers' employees numbered 12,300 in July, compared with 11,000 in June.

★Kennecott's Ray Division mines are now producing only 5,000 tons of ore per day, a sharp decline from the 9,000 tons per day maintained during the war. Officials ascribe this to the shortage of manpower. The payroll now numbers only 500 men.

★W. G. Hokett has bought the Harcuvar copper-gold mine, in Yuma County. A 269-ft. tunnel and several prospect shafts are being opened.

★Diamond drilling is reported to be under way at two Arizona mines, the Ruth, owned by Calari Mining Co., and the Sunset Mining Co.'s property near Superior.

TRI-STATE

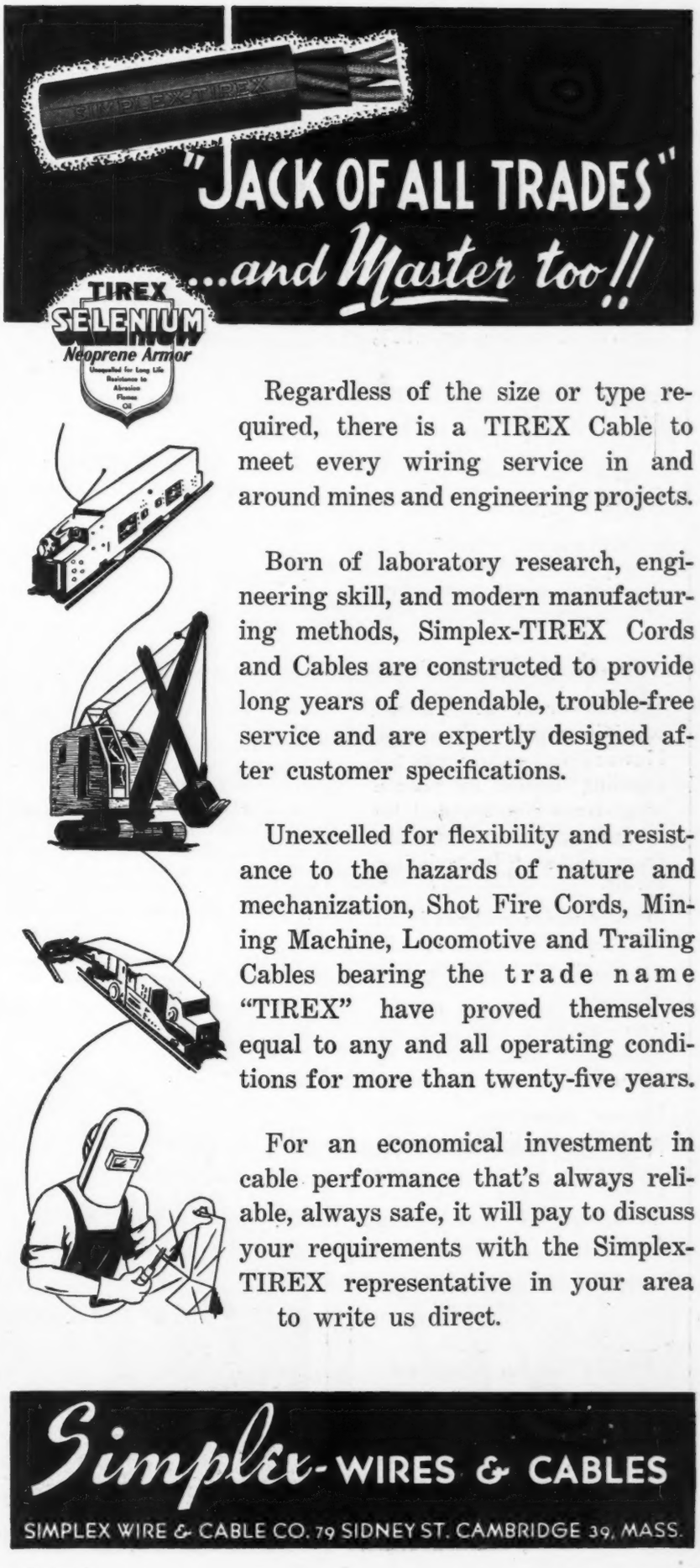
Shaft sinking about to start on Vanatta Lease — MacArthur begins work on Sparlin land

★Fred J. Childress & Sons, with L. L. Smith, of Joplin, are about to start sinking a shaft 425 ft. deep on the 160-acre Vanatta lease, near Melrose and bordering the Kansas-Oklahoma State line on the south and 6 miles west of the Picher field. More than 30 churn-drill holes have been put down on the tract in the last two years, 8 to 10 of them by the U. S. Bureau of Mines. Harold Childress, who will be in charge, states that the average assays of drill cuttings ran about 5 percent in recoverable zinc and lead. A 12¼-in. hole is now being finished near the site, to which a road will have to be built. A 10-in. Pomona turbine pump, with 12-in. bowls, will be installed in this hole to handle the heavy flow expected. A 475-cu.ft. Sullivan compressor will be installed, and a wooden derrick and 300-ton hopper are to be moved from the Childress-Heggem lease, near Cardin. Later a bigger compressor will be installed for mining. The Childress group has obtained a Government loan of $75,000 to develop the mill site blocked out by the drilling. However, the ore will be sent to United Zinc's Park-Walton mill near by.

★MacArthur Mining Co. has started to sink a shaft on the Sparlin land, three miles west of Baxter Springs and just north of U. S. Highway 166, according to J. W. Hoffman, of Joplin, general manager. The lease, comprising a quarter-section, is opposite the company's two original mines on the Embry 160-acre tract. The shaft will be put down ultimately to a depth of 410 ft. into the sheet ground, but an upper run of ore in the M-bed formation from the 325 to 335-ft. levels will be mined first. Extensive drilling has been done in the last few years.

★F. W. (Mike) Evans has acquired a lead-zinc, with a trace of silver, property in Colorado, near Westcliff, 70 miles southwest of Cañon City. It is known as the New Hope mine. A shaft is to be sunk to 300 ft. depth. M. B. Martin is in charge.

★NLRB elections held among the employees of 13 mining companies in the district this year to determine whom they would have as collective bargaining agent have resulted, in 12 instances, in the selection of the International Union of Mine, Mill & Smelter Workers (CIO). The single exception was that of Cameron & Henderson, whose employees voted 43 to 26 against the union. This mining firm operates the Admiralty mines, south of Picher, and the Romo mill, near Lincolnville. The twelve companies whose employees voted in favor of the union are Marcia K. Mining



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Tri-State *(Continued)*

Co., Mahutska Mining Co., Big Chief Tailing Co., Scott Mining Co., Tri-State Zinc, Inc., Cardin Mining & Milling Co., American Zinc Co. of Oklahoma, Harris Mining Co., Atlas Milling Co., Davis-Big Chief Mining Co., MacArthur Mining Co., and Eagle-Picher surface employees. Prior to this year, employees of the following Tri-State companies had been organized by the international union: St. Louis Smelting & Refining Co., Kansas Explorations, Inc., Federal Mining & Smelting Co., Rialto Mining Corporation, M. & W. Mining Co., Oronogo Mutual Mining Co., and Fenix & Sons.

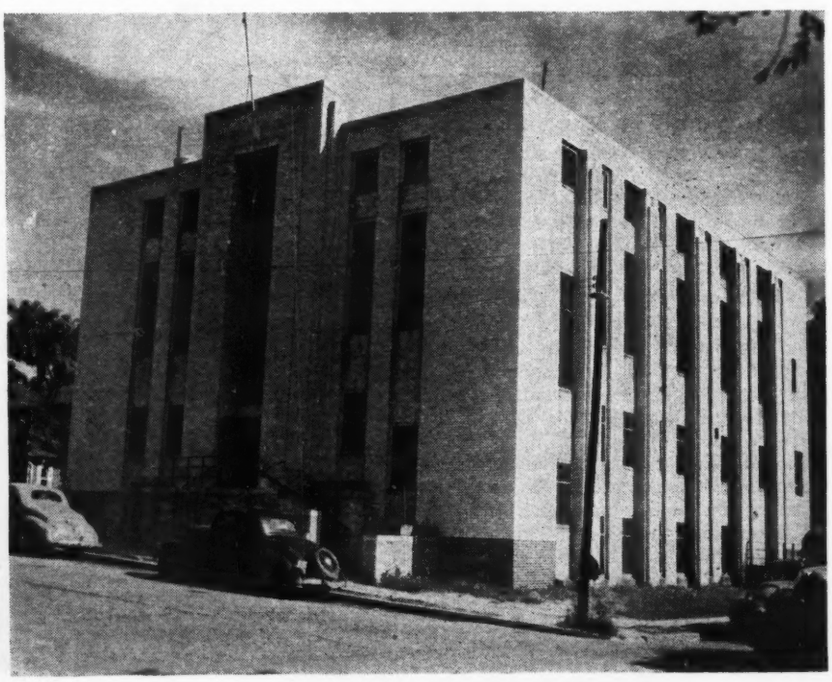
MISSOURI

Buehler Building dedicated at Rolla — Enrollment for mining and metallurgy about 500

★Final registration figures at the Missouri School of Mines, at Rolla, show an enrollment of over 2,100. Students in mining and metallurgical engineering make up about 25 percent of the total. In the mining department are 325, and in the metallurgy department 172. More than 82 percent of the total are veterans studying under the G.I. Bill of Rights.

★Buehler Building, the new headquarters of the Missouri Geological Survey at Rolla, shown in an accompanying view, was formally dedicated during observance of "Missouri Geology Day" on Sept. 27. Governor Donnelly of Missouri hoisted the state flag over the building during a colorful ceremony. Among the speakers, in addition to the Governor, was Dr. Morris Leighton, chief of the Illinois Geological Survey, and Howard I. Young, president of the American Mining Congress and president of the American Zinc, Lead & Smelting Co. The Missouri Survey was founded in 1854 and has functioned continuously since 1890. The present staff includes 14 geologists and engineers, in addition to laboratory assistants and secretaries.

THE BUEHLER BUILDING, new headquarters of the Missouri Geological Survey, at Rolla, was formally dedicated on Sept. 27.



ARKANSAS

New effort to work diamond ground in Pike County revealed

★A temporary restraining order to prohibit the Diamond Corporation of America from disbursing or withdrawing any funds from a $325,000 special account in the First National Bank of St. Louis, Mo., has revealed that Glenn L. Martin, aircraft builder, of Baltimore, is interested in development of the diamond mines near Murfreesboro, Pike County, Ark. The complaint filed revealed an investment to date of $400,000 in the diamond property. The Pike County deposit is the only known diamond-bearing peridotite plug in North America, and has been subject to controversy and promotion in the past. Previous operations failed, although a quantity of fine gem stones, as well as industrial diamonds, have been mined and marketed. Exploration was done on the property by the U. S. Bureau of Mines during the war, but the results

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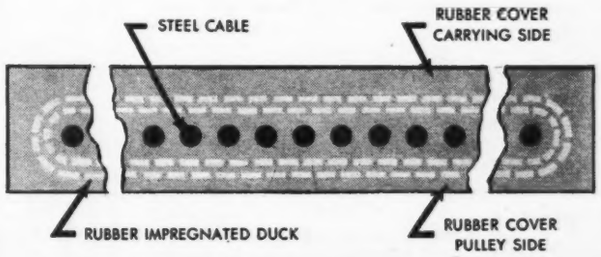

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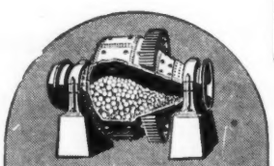
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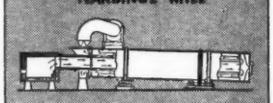
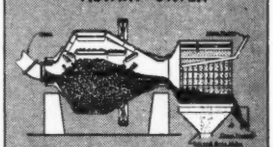

ROTARY DRYER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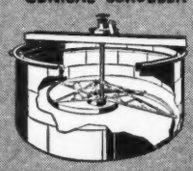
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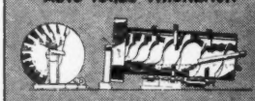
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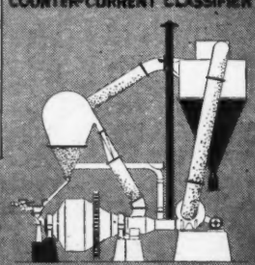
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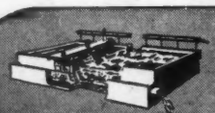
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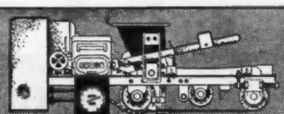
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Arkansas (*continued*)

have not been made public. Since then a geophysical program has been carried on in the area by private parties.

★Thomas A. Jones, mining engineer for the U. S. Bureau of Mines, has been sent to Little Rock to reestablish a mineral investigation service in the State for the Bureau's mining branch. First on the agenda is a study of barite occurrences in the Ouachita Mountains. Mr. Jones was engaged in the work on bauxite in Pulaski and Saline counties during the war.

★Attention has been called to certain errors in the following paragraph, published on p. 118 in the September *E.&M.J.* The item reads: "It is reported that the Maumee mine, at the Buffalo River ford in the Maumee County zinc field, is ready to begin production under direction of the owner, Ed. Zimmerman. Tom Matlock is mine foreman. Shafts extend to 90 ft. of depth, and several veins have been opened." As corrected, the paragraph would state that the mine is in Searcy County (not Maumee); that it is owned by the Bank of Farmington, Farmington, Mo.; and that Ed. Zimmerman has charge of operations.

ILLINOIS and KENTUCKY

New heavy-media plant is started at Rosiclare — WAA dismantling the Corod mill

★The fluorspar plant of the U. S. Coal & Coke Co. at Mexico, Crittenden County, Ky., which has been shut down by a strike since April 26, resumed maintenance operations Oct. 7 and, at time of writing, is scheduled to start production Nov. 1. Resumption followed a 10¢-per-hour wage increase, agreement on a vacation-wage plan, and adjustment of shift-differential premium payments of 4¢ and 6¢ per hour for evenings and night shifts respectively.

★The fluorspar division of the Aluminum Ore Co., at Rosiclare, Ill., began operation of its new heavy-media separation plant in October. Rated capacity is 25 tons per hour. The new mill was installed to raise the grade of feed sent to flotation.

★Rejecting all bids for purchase of the government-owned Corod fluorspar mill, at Marion, Ky., as a unit, the War Assets Administration now is dismantling the plant and offering the equipment for sale. The plant was built during the war for differential flotation of zinc, lead, and fluorspar.

★Minerals Flotation Corporation has resumed operation of its fluorspar flotation mill at Marion following a shutdown due to the coal strike.

MICHIGAN

C.&H. president voices hope for future of copper range — Isle Royale pays dividend

★E. R. Lovell, president of Calumet & Hecla Consolidated Copper Co., said in a recent statement that "the copper country of Michigan is far from through as a mining district." He declared that "large reserves of low-grade ore are known to exist that can be mined at high prices for copper. The possibilities of finding additional high-grade deposits have by no means been exhausted. The search will go on. Human ingenuity will be used to the utmost to devise better and cheaper methods of winning copper from the ground. If the mining industry can be afforded some measure of relief from bureaucratic straitjackets and rising wage and supply costs, if reasonable incentives are provided for continuing the search and development of new deposits, the mines of the Michigan copper district should produce for many years to come."

Mr. Lovell outlined some of Calumet & Hecla's activities in the field of perpetuating the Michigan district and broadening the base of industrial stability. They are:

Millions of dollars have been and are being spent in diamond drilling and underground exploration in the ceaseless search for new orebodies. New mineral lands are constantly being acquired.

Calumet & Hecla has organized a secondary copper department, employing 108 men, and is treating large tonnages of scrap copper.

In conjunction with the Harshaw Chemical Co., of Cleveland, the Lake Chemical Co. was organized in 1945 and located at Hubbell for the purpose of manufacturing and selling chemicals. The company has embarked on the commercial foundry business and is using its excess foundry capacity to make castings for mid-western concerns. The company is about to set up a new department for the manufacture of detachable drill bits for its own use and for sale in a large part of the United States. The lands owned by the company are being rapidly developed for resort purposes.

★Calumet & Hecla's Seneca shaft No. 2, formerly the Gratiot, in which mining operations will soon be resumed, has been cleaned from the surface to the 12th level. New wooden stringers have been installed in the concrete sleepers to a depth of 300 ft. This replacement will continue throughout the shaft. The concrete mat to support the foundations of the engine house and hoisting house has been poured and work on the foundations is under way. The railroad line connecting the property with the Keweenaw Central line has been completed and trains are operating over

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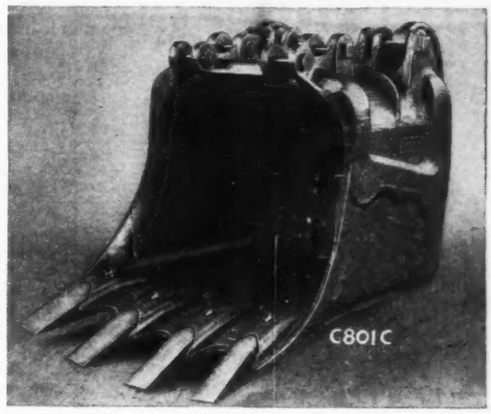
Design, in a dipper, affects durability, but the use of austenitic manganese steel, "the toughest steel known," as the sole material of construction in these dippers, except for small complementary parts, assures maximum resistance to impact and wear.

The important factors of design in a power shovel dipper are those which contribute to faster, more efficient digging, full loading, with maximum proportion of power consumption applied to payload, quick dumping and longer life. All these characteristics are embodied in the Amsco All-Manganese Steel Welded Type Dipper.

When fitted with a door and bail of adequately strong design, this dipper is somewhat lighter in weight than the Amsco Renewable Lip Dipper, thousands of which have been put into use since 1928. If made with a lightly constructed door and hinges, as generally used in light weight dippers, it will not exceed the weight of any composite-type fabricated dipper that is sufficiently strong to do a good job. The dippers illustrated have the advantage of a manganese steel body welded into an operating unit. The body is as strong and homogeneous as if made in one piece. At the same time it is possible to remove a worn front and weld on a new one without destroying the back.



C-801C. Amsco All-Manganese Steel Welded Type Dipper (Patented)

The Amsco All-Manganese Steel Welded Type Dipper is made in capacities of ¾ yd. and up. Sizes ¾ to 2 yd. are made in two body pieces; front and back. Sizes over 2 yd. are made in four pieces; front, back and two side plates. Write for full information.

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Michigan *(continued)*

it, bringing supplies and equipment to the mine. A mile of 6-in. pipe is being laid between Mohawk and the Gratiot to supply water for the mine.

★Isle Royale Copper Co. is paying a dividend of 50c. per share Oct. 17 to stockholders of record Sept. 24. This is the third dividend declared by the company since the resumption of operations in 1937 and will represent a total return of $1.30 per share since that time. A total of $1.50 a share was called in the way of assessments to unwater the mine and rehabilitate the mine, mill and railroad, so that the third declaration falls short of reimbursing the stockholders for money advanced to reopen the property, with no return on the original investment thus far.

IRON COUNTRY

Easing of tax burden is sought—International Harvester strike enters ninth month

★At a recent hearing of the State Tax Commission in Marquette, Mich., following protests filed by Cleveland-Cliffs Iron Co., the valuation of the Lloyd mine, in Ishpeming. Township, was reduced from $935,000 to $859,000. Oliver Iron Mining Co. also received a reduction on the Champion mine, in Champion Township, from $500,000 to $400,000. Lower valuations were asked on the Maas, Athens, and Mather properties, but the board refused to take action.

★At a meeting of mining men and state legislators from the three Michigan iron ranges held in Crystal Falls Sept. 24, plans were discussed to draft legislation to ease the tax burden on iron mines so as to increase their life. The practice of assessing a mine at its full value discourages operators from exploring for new reserves.

★At the North Range Mining Co.'s Book mine, near Crystal Falls, the concentrator is operating on low-grade ore stocked when the mine was first stripped for open-cut work. The product from underground mining is direct-shipping and is loaded from the shaft pocket. With three shifts per day the season's output is expected to approach 90,000 tons. More than 60,000 tons has already been shipped. R. S. Archibald is manager.

★W. A. Knoll, general superintendent of iron mines on the Gogebic and Marquette ranges for Pickands, Mather & Co., was elected chairman of the Upper Peninsular Section of the A.I.M.E. at a recent meeting in Iron River, Mich. He succeeds Rudolph Ericson of Iron River.

★The Bureau of Mines has discovered new traces of iron deposits in north-central Minnesota, and is going to make a further study of the most promising ones. A Minneapolis concern has made reconnaissance magnetic surveys for the government for 200 miles between the western end of the Mesabi and the northern limits of the Cuyuna. More detailed surveys are planned of deposits south of the town of Emily, along the northern part of the Cuyuna Range, and north of Deer River.

★International Harvester mine-workers' strike has entered its ninth month. The deadlock has been over the maintenance of membership clause, which the United Steelworkers (C. I. O.) has insisted on, and which the company has consistently refused to accept. Negotiations have broken down time after time over this divergence in policy.

★Another underground mine in Hibbing, the Webb, has exhausted its underground supplies of iron ore but will continue to operate as an open pit. The Webb, owned by the Shenango Iron Mining Co., is east of Hibbing and is one of the oldest underground properties in the district, having started in 1906.

ALASKA

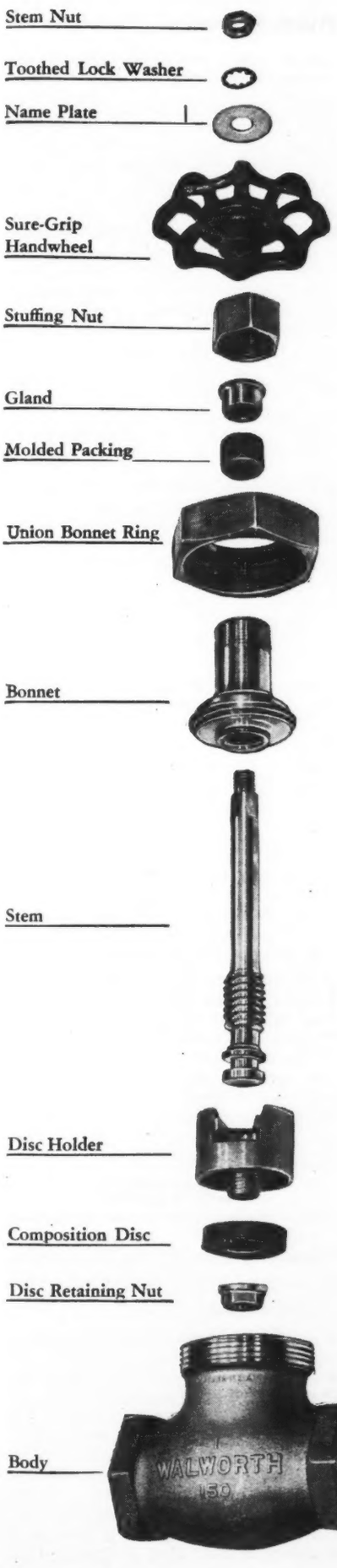
Goodnews Bay company working late — Flagstaff under option to Santiago Alaska

★C. E. Pohl, of San Francisco, and Walter Johnaon have constructed a ditch line and installed a pumping plant on their property, east of Nome. They plan to start dredge work next season.

★Ernest J. Rupert, of Seattle, was on Atwater Bar, near Chicken, with Herman Eckstrom, the past summer. He reports negotiating with Eastern interests for a lease. Eckstrom will do further prospecting this winter. Rupert reports that the Fortymile placer area is very active. Merton J. Atwood has taken over Frank Barrett's property on Stonehouse Creek, and will remain in Chicken for the winter. Fred Whitehead and partner have worked successfully on Upper Chicken Creek. Billy Meldrum is opening ground for next season's work. B. B. Green is working on Jack Wade Creek. Al Stout and two associates are on Napoleon Creek, and Syvert Kolland expects to continue mining in the Chicken district during the winter.

★The Flagstaff mine, on Karta Bay, Prince of Wales Island, was taken under option by Santiago Alaska Mines, Inc., of Vancouver, Wash., in September, from R. Crowe Swords, president, according to word in Ketchikan.

★Charles Johnston, treasurer of Goodnews Bay Mining Co., will be at the property until late in November. Operations will continue as late as possible. Mr. Johnston will return to



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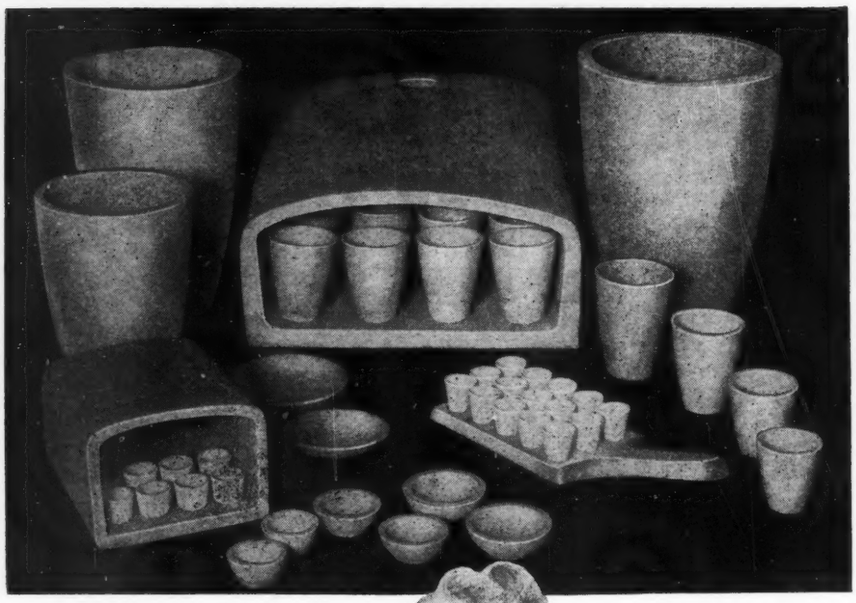

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Alaska (*continued*)

Seattle. He is president of the Alaska Miners Association.

★Bott Brothers, Joe Blondell, and Fred Terrill are mining on Bettles River, according to Jack McCord, who came into Fairbanks after prospecting on Big Lake, Bettles River, and Mathews River.

★Kuskokwim Mining Co. stopped work late in September because the boats ceased running earlier than usual, and there was no way of shipping the mercury out, according to O. E. Wahto, of Sleetmute, in charge.

★A new vein has been discovered at Salmon gold mine, in the Portland Canal area. Assays are said to show 0.61 oz. gold and 5 oz. silver. A low level tunnel has been extended 100 ft. and is now in about 200 ft.

★C. R. Earley, of the University of Alaska, has announced the following schedule for mining classes in the Territory: Ladd Field at Fairbanks, Sept. 20 to Oct. 20; Seward, Oct. 25 to Nov. 25; Ketchikan, Dec. 1 to Jan. 1; Wrangell, Jan. 5 to Feb. 1; Juneau, Feb. 3 to March 3; Haines, March 4 to April 5; Skagway, April 5 to May 10; Sitka, unscheduled.

★Mining operations in the Ophir-Takotna, and Medfra districts are proceeding in a small way. A $50,000 shipment of gold went through McGrath in September, according to reports. Labor is scarce in spite of high wages. There is some talk of bringing contract labor from outside next year.

★Colonel Mallar and co-workers are employing 21 men in a drilling program at La Fontaine workings between Beaver Pass and Stanley. Bedrock was encountered at 115 ft. in one hole and another is being sunk.

★According to Homer H. Tilley, of Tacoma, Wash., the road to the Lucky Nell mine, at Hollis, on Prince of Wales Island, under contract to Clyde S. Maxwell, will be finished this fall, and mill machinery will be installed and tunnel work begun. James J. Mataska is in charge.

CANADA

Winnipeg meeting studies mining problems—International increases nickel output

★Leading representatives of the mining industry throughout Canada as well as technical advisers from the Dominion Government and all the provinces, who make up the so-called Interprovincial Committee on the Mining Industry, met in Winnipeg, Sept. 23-27, to discuss a wide range of problems relative to the industry. (This committee, which was appointed two years ago in Vancouver, held general meetings in 1945 also, at Quebec City

and Toronto, respectively). Four subcommittees were named.

Problems considered by the subcommittees concerned geological surveys and aërial photography; industrial minerals; coordination of research; regulations relating to staking, the operation of mines and safety; conservation measures pertaining to oil and gas; coal; and taxation. Other topics of particular concern to mining men in remote areas were transportation, and municipal and townsite problems. Security regulations, workmen's compensation, and other allied matters were also discussed. Recommendations were formulated for consideration by the Ministers who came together for the purpose. In turn the Ministers Committee recommended:

1. That a Royal commission be appointed to examine the whole field of mineral taxation.

2. That coal should be declared a national public necessity, and that there should be a national coal policy formulated.

3. That conservation of all mineral resources be considered of prime importance and that representatives from each province be appointed to study it and report at the next conference.

4. That, within a province, research activities of the Government, universities, and industries should be co-ordinated; that there be a wider exchange of the results of research by all institutions engaged in it; and that, wherever possible, co-ordination of research within a province should be the responsibility of the provincial institution doing research.

5. That more liberal grants should be made to universities and provincial research organizations. Private donations to universities and provincial research institutions should be encouraged by removal of taxation and of existing restrictions on such gifts.

With regard to photographic mapping and geological surveys, the conference went on record in favor of the Dominion Government taking the responsibility for the aërial photography and topographic mapping of Canada, and urged that this be done at such a rate that the unexplored portions of the Dominion would be mapped within 10 years.

L. D. Currie, Minister of Mines and Labor for Nova Scotia, was elected committee chairman for 1947 to succeed J. S. McDiarmid, Minister of Mines for Manitoba. Halifax, Nova Scotia, was chosen for the next conference.

★Gen. A. G. L. McNaughton, Canada's representative on the Atomic Energy Commission, on Oct. 14 volunteered to give the United Nations information on the mining of uranium and thorium, saying Canada was prepared to help in any way.

★Large-scale activity in the Yellowknife area of the Northwest Territories is indicated by the 21,000

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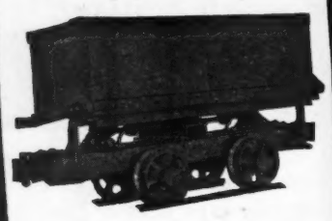

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Canada (*continued*)

mining claims that are reported in good standing, the 45 diamond-drill machines that were working in the 1946 field season, and the exploratory work recently carried on by more than 70 companies. The permanent population of the town of Yellowknife has increased to about 2,000. In addition about 1,500 men are working in the surrounding area. Construction is now in progress of a water-power project on the Snare River to produce 8,000 hp., in addition to the 4,700 hp. developed by Consolidated Smelters on the Yellowknife River. Construction has been started of a 386-mile all-weather highway leading from the end of the railroad at Grimshaw, Alberta, north to Great Slave Lake.

ONTARIO

★International Nickel Company of Canada, Ltd., after cutting back more than a year ago to four reverberatory furnaces, in October brought in the fifth and sixth reverberatories to increase nickel output by about 40 percent. Compared with the wartime peak of about 12,000 tons a month, the new production rate is to exceed 8,000 tons monthly. The large surplus stocks of metal held by International have been steadily reduced. Renewed market demand is also being shown for copper, which is to be produced at a rate of upwards of 12,500 tons a month compared, with the 1941 peak of 14,500 tons.

★Ontario Nickel Mines, Ltd., has announced a development program laid out by S. J. Kidder, consulting engineer, to test the main ore zone at greater depth and laterally. A 400-ft. ore lens recently tested by drill holes from the 250 level disclosed sections grading 1.22 percent nickel and 0.65 percent copper across 62 ft.; 1.40 percent nickel and 0.26 percent copper across 11.5 ft.; and 3.43 percent nickel and 0.63 percent copper across 20 ft., in addition to other intersections that showed good grade. At an average depth of 350 ft. a combined grade of 2.96 percent across 28 ft. was secured in another drill hole.

★Shipments of ore from Steep Rock Iron Mines are expected to approach a total of one million tons for the 1946 season. Mine capacity has been expanded to 10,000 tons a day, but shipments are limited by railroad facilities. August shipments were at a new record of 170,000 tons, ranking second in Canada to International Nickel for ore movements. Plans have been made by the management to increase annual production within the next four or five years to three million tons, equivalent in value to the fourth largest mine in Canada, with profits estimated at better than $5,000,000 a year.

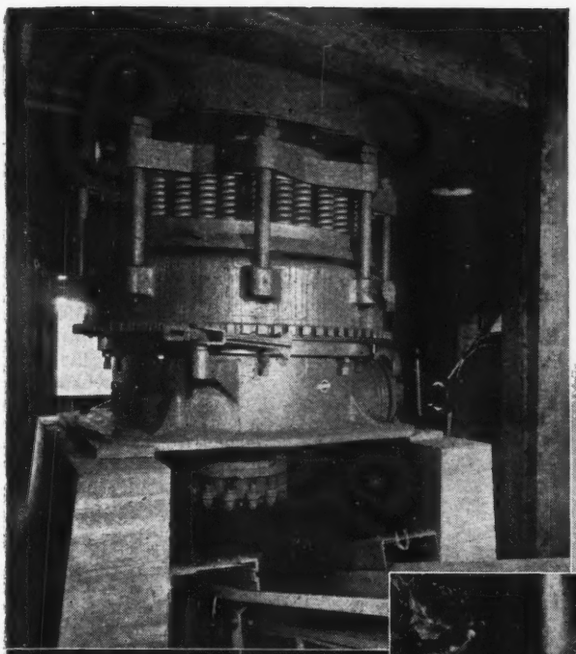
★American Nepheline, Ltd., controlled by Ventures, Ltd., has announced that $286,000 is being spent to provide electric power and to build a new plant. Coarse grinding of the syenite in the new plant at the mine will turn out 6,000 tons a month of glass-grade product. The coarse product will be shipped 20 miles from the mine to Lakefield and to Rochester, N. Y., where fine grinding will prepare the product for pottery and ceramic uses. The wholly-owned American Nepheline Corporation at Rochester can produce 2,000 tons of glass-grade per month, but completion of the new plant at the mine will make it possible to do all coarse grinding at that point for a glass-grade product. The Rochester and Lakefield plants will operate fine-grinding equipment to produce ceramic materials. Estimated reserves from the open pit and underground are 950,000 tons. Ernest Craig is manager.

★McKenzie Red Lake Gold Mines, Ltd., reported total production to the end of June 1946 at $9,622,509, an average of $11.96 per ton. During August the mine treated an average of 203 tons daily, grading $7.61 a ton. Exploratory work both in the southeast and northeast sections of the mine on the 12th level has recently shown favorable ore values and widths. When miners are available it is planned to run a crosscut on the 1,650-ft. level out to the adjoining McCuaig property. This work would provide set-ups for diamond drills to test the ore structure to a depth of about 2,200 ft.

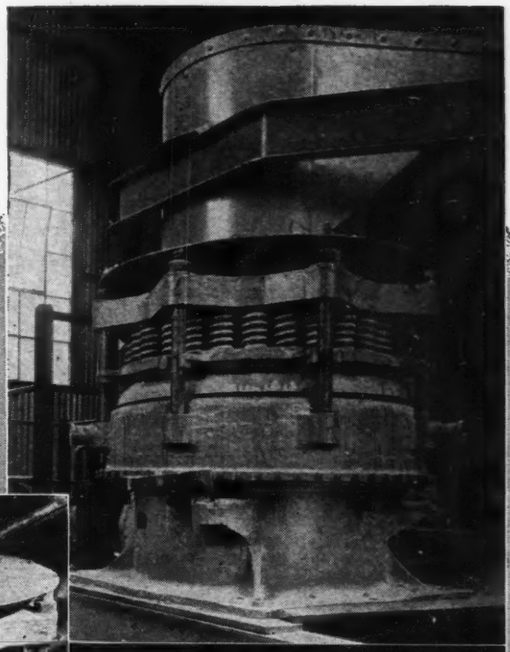
★Hasaga Gold Mines, for which J. E. Hammell, president, has considered erecting a 1,000-ton mill, is now trucking ore to the mill located more than a mile away on the property of the former Red Lake Gold Shore Company. The mill has a capacity of 350 tons a day, compared with about 300 tons daily treated last summer and a rate of approximately 150 tons averaged in September. At the reduced scale a better grade is reported. The winze is being raised through to surface as the No. 3 or main operating shaft, for which a new headframe has been completed. The winze has been deepened to 2,450 ft. in preparation for developing three oreshoots located some time ago by diamond-drilling.

QUEBEC

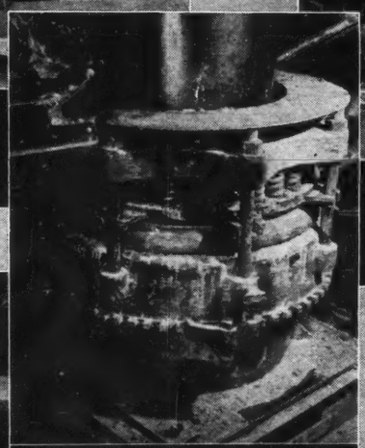
★New Calumet Mines, Ltd., which was brought into production late in 1943 through funds advanced by Frobisher Exploration, Perron Gold Mines, and Nesbitt, Thompson & Co., has reached the stage where all debts can be liquidated within the next 12 to 18 months. Bank debts amounting to $350,000 have been paid off, and cash on hand and metal stocks outstanding now amount to about $600,000. Lead and zinc concentrates have been shipped under contract with the Office of Metals Reserve, payment being made at the prevailing New York prices. The contract expires late this year, when it is



UNITED STATES—Snyder Mining Co., Duluth, has 48" Gyrasphere in Virginia Mine, Eveleth, Minn.



SOUTH AFRICA—New Kleinfontein Gold Mining Co., in Benoni, Transvaal, operates a 36" Gyrasphere.



CANADA—Granby Consolidated Mining, Smelting & Power Co., Ltd., Allenby, B.C., has 36" Gyrasphere.

MEXICO—Santa Maria de la Paz y Anexas plant in Matehuala, S.L.P., uses a 24" Gyrasphere.

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Canada *(continued)*

expected to be renewed. Ore reserves are estimated at more than a million tons of a better grade than previously known. A long-term production policy has been adopted to provide for deepening both the No. 1 shaft, to 1,000 ft., and the No. 2 shaft to 500 ft. A winze will also be put down to develop the ore zone indicated by diamond drilling. The mill rate has held between 500 and 600 tons a day.

★J. F. Clarke, manager of Mackwa Mines, reports that drilling has been started on the company's 900-acre property in Senneville Township to test results of a magnetometer survey. J. T. Randall, consulting engineer, stated that the north contact zone of the Bourlamaque batholith had been outlined under heavy overburden. This is to be intensively tested.

★Drifting on the main No. 1 vein at the second or 400-ft. level of Elder Gold Mines has exposed a 300-ft. length of good ore, with an average gold content estimated at $10 per ton. The No. 1 vein is also being explored on the first and third levels, the widths ranging from 2.0 to 8.5 ft. The development rock averages 72 percent silica, which is being sent to the Noranda smelter. Regular ore shipments are to follow.

★Golconda Mines, Ltd., reports favorable results from 18,600 ft. of diamond-drilling along the main ore zone on its property in Duparquet Township. The length of the main vein along a porphyry contact has been extended to 2,100 ft., and favorable possibilities are shown for three other zones. A 1,400-ft. section of the main vein gave an average gold content of $8.71 per ton for a width of 5.7 ft., as indicated by the drill results. Plans have been announced for further diamond drilling, involving 15,000 ft., to test the structures associated with the Porcupine-Destor fault zone. The proposed program also provides for 500 ft. of shaft sinking and underground exploration, at a cost, including diamond drilling, of $195,000 to $200,000. B. S. Parkinson is president, and John B. DeMille is consulting geologist.

★Work in progress from the new shaft at Wasa Lake Gold Mines, Ltd., near Arntfield, has opened a 19-ft. width on the main ore zone at the 400-ft. level. The mineral content is reported to resemble drill core from the best sections recovered in exploratory work, which indicated a full width of about 30 ft. in this zone. Drilling entered the same structure at shallower depths and at the 600-ft. horizon, giving values of 0.163 to 0.20 oz.

MANITOBA

★Work by Howe Sound Exploration Co., Ltd., at Snow Lake is progressing despite difficulties. The transmission line from Sherridon, on which construction was suspended due to an early break-up, is being cleared to

make power available as early as possible in 1947. The five-compartment shaft has been collared and the steel headframe is being erected by the Manitoba Bridge and Iron Works, Ltd. Work on improving the road from Mile 82, on the Hudson Bay Railway, to Herb Lake, and on the northern section of 6 miles from Herb Lake to the mine site, is nearing completion. Installation of a diesel plant will be completed as soon as road conditions permit. This plant, which is to be used eventually as a standby, will make it possible to resume shaft sinking.

★Squall Lake Gold Mines, Ltd., in which Wekusko Consolidated, Ltd., holds a controlling interest, reports a new discovery on the south end of Macleod Lake, three miles northeast of Snow Lake. The first trench in the new showing exposed a mineralized width of 120 ft.; values over 70 ft. were: 0.346 oz. gold uncut or 0.225 oz. gold cut grade. In contrast to the relatively flat bodies in which exploration to date has been confined, the new find dips almost vertically. Diamond drilling is now under way.

★Prospectors employed by International Nickel Co. recently staked a block of 80 claims near Hughes River, northeast of Lynn Lake.

★As a result of the return of Canadian and United States currencies to parity, the second dividend of the year declared by San Antonio Gold Mines, Ltd., was 7c., in contrast to the customary 10c. per share. A readjustment of production policy has not been possible immediately. The company is continuing to diamond-drill the gold property, on which it has an option, 9 miles east of the parent mine.

★Gold Pan Mines (1945), Ltd., south of the San Antonio mine, in the Rice Lake area, is letting a contract for 8,000 ft. of deep diamond-drilling. The program carried out the past summer was confined to shallow drilling and geological mapping. The old workings are being dewatered, and when this is completed, underground mapping and sampling will be undertaken. Dr. W. R. Newman is in charge.

★Wekusko Consolidated, Ltd., has completed shaft sinking to 560 ft. on the Ferro property, at Herb Lake. Drifting on the 275-ft. level has revealed a length of 51 ft. south of the shaft grading 0.146 oz. gold across 5 ft. and a northerly section carrying 0.273 oz. gold across 3.4 ft., for a length of 45 ft. Drifting just started on the third level has averaged 0.57 oz. gold across 1.5 ft.

★Recent drilling on the Sherritt Gordon nickel-copper deposit at Lynn Lake has materially increased the tonnage of the "E" orebody. Hole No. 96, 50 ft. west of No. 93 and 100 ft. south of No. 87, averaged 1.27 percent nickel and 0.58 percent copper from 484 ft. to 815 ft. The hole was stopped at this point, as the drill could go no deeper. Hole No. 100, 150 west of No. 65 and 100 ft. north of No. 78, averaged

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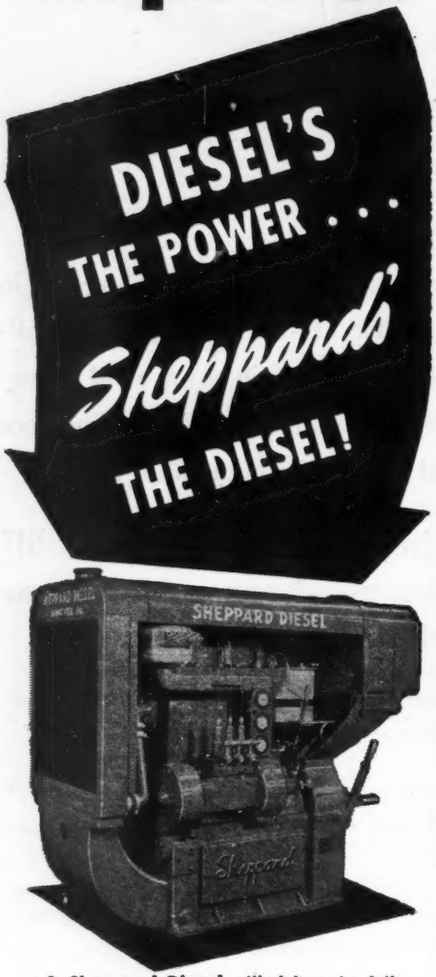

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Canada *(continued)*

0.71 percent nickel and 0.52 percent copper from 100 ft. to 127 ft. Hole No. 104, 100 ft. north of No. 87, averaged 0.48 percent nickel and 0.21 percent copper from 622 ft. to 630 ft. and averaged 1.8 percent nickel and 0.20 percent copper from 630 ft. to 690 ft.

★Drilling to date on the new Farley Lake gold occurrence has been inconclusive. The best intersections obtained have been 0.06 oz. gold for a core length of 20 ft. and 0.34 oz. gold for a core length of 5.5 ft.

BRITISH COLUMBIA

★ Prospects of a settlement of the prolonged strike of metal mine-workers in British Columbia against the copper operators appears to be much improved after the recommendations formulated by Chief Justice Gordon Sloan, commissioner appointed by the Dominion Government, were published. They were made to C. H. Locke, operators' representative, and to Harvey Murphy, Western regional director of the International Union of Mine, Mill and Smelter Workers. The recommendations were as follows:

1. Wages of miners and timbermen to be increased by 64¢ a shift.

2. Wages of other than miners and timbermen to be increased by 48¢ a shift.

3. The June copper bonus of 25¢ per shift to be absorbed in the increases in the basic wage rates.

4. All employees to be paid the 25¢ copper bonus due in August and September and in the future (subject to Item 5) on the following basis (provided the companies' concentrates are being produced, shipped, and smelted without interference):

If the average export price of copper at New York, as quoted by *Engineering and Mining Journal*, hereafter exceeds 14½¢ per pound for a calendar month, the company will thereafter, so long as such price exceeds 14½¢ per pound, pay a copper bonus of 25¢ per shift to each employee; the company will pay a further copper bonus of 25¢ per shift to each employee if the said average price as quoted by the *Engineering and Mining Journal* for a calendar month, exceeds 16¢ a pound for so long as the said export price exceeds such amount; the company will also pay a further bonus of 25¢ when the said average price for any calendar month, as quoted by the *Engineering and Mining Journal* exceeds 17½¢ a pound for so long as the price exceeds that amount.

5. The companies to guarantee to pay, when in operation, to all employees on each shift for the first nine months of the contract a sum equal to the two copper bonuses, payable in August and September—i. e., 50¢ per shift, regardless of the average export price of copper during the said nine months' period.

6. A shift differential of 3¢ per hour in the second shift and 5¢ per hour in the third shift to be instituted.

7. Hours worked in excess of 44 in any one week to be paid for at the rate of time and one-half.

8. The covenants relating to "check-off" in the 1946 Coast loggers contract to be adopted.

9. The foregoing to be subject to all relevant Dominion and Provincial laws.

The way these recommendations would affect miners and timbermen is shown as follows (wages being increased 14½¢ per hour): Adding 64¢ per shift to the present base rate of $6.37 per shift (or 79.6¢ per hour) gives the proposed base wage rate of $7.01, or 87.6¢ per hour. With addition of the guaranteed bonus of 50¢ per shift, the proposed rate is brought to $7.51 per shift, or 93.8¢ per hour. For other than miners and timbermen the increase on the same basis would amount to 12½¢ per hour.

Adding the approximate average shift differential (21¢ per shift) and overtime (30¢ per shift) payments, the total miner's earnings would be $8.02 per shift, or 100.1¢ per hour.

The committee report has been submitted to a bitter attack by officials of the International Union of Mine, Mill and Smelter Workers, who demand that its members resign. In contradiction to the stand of the Mines Department, the Hon. George S. Pearson, Minister of Labor, holds that mining is not exempt from the Acts provisions and has stated a test case will be made by notifying the Consolidated Mining & Smelting Company of Canada, Ltd., that the 44-hour week applies to operations of that company in British Columbia and threatening to begin prosecution proceedings unless the law is observed.

★ Improvement in labor supply in recent months has permitted Polaris-Taku Mining Co., Ltd., Atlin district, to increase tonnage milled from 140 daily to 180. Present capacity is 300 tons daily, and equipment, including a new crusher and flotation unit, is being installed to raise it to 500 tons daily. The company's consulting geologist has advised the management that, with a minimum of development work, it was reasonable to expect a threefold increase in ore reserves, now estimated at 330,000 tons averaging 0.343 oz. gold per ton. Drifting on the new vein recently intersected on the "B" level, 300 ft. above the Polaris (main) level, now extends for 75 ft., all in ore, and shows an average width of 3 ft. and grade of 0.53 oz. gold per ton. The vein has also been intersected by diamond drilling from the "C" level on an horizon 150 ft. above the drift.

★ For the first time since its incorporation 10 years ago, Silbak Premier Mines, Ltd., will omit payment of its regular semi-annual dividend during the second half. The company's Portland Canal property has been closed since July 3 by the miners' strike.

★ Underground work at the Portland

Loaded Mack FCSW's climbing the 8% grade from the pit to the crushing plant.

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Here again is proof of Mack's outstanding heavy duty qualities. Macks have always been leaders in handling the most gruelling jobs. They *work harder, give economical service* and *last longer!* Consider Mack for *your* hauling problem.

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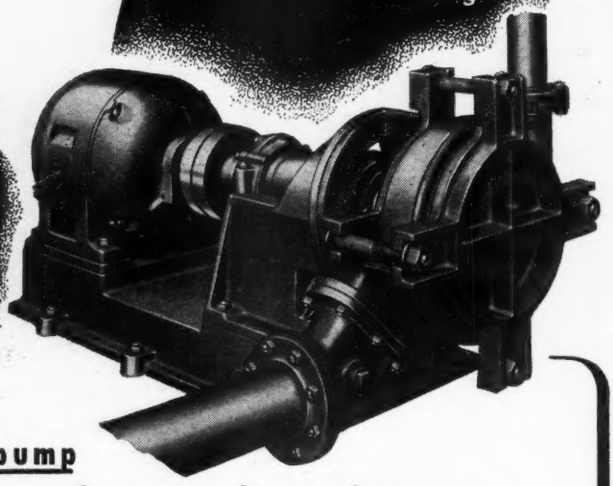

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Canada *(continued)*

Canal property of Big Four Silver Mines, Ltd., has been retarded by the need for doing as much surface construction work as possible before winter. Erection of a permanent camp at the main Silverado portal, tramline construction, and road building require so many men that only one development crew is at work underground. E. G. Langille, mine manager, states, however, that this situation will be changed as soon as the snow comes, when most of the crew will be concentrated in the mine. Recession of the Silverado glacier has given surface indication of extension from 600 to 800 ft. of the Nos. 1, 2, and 4 veins. The zero tunnel is being advanced to reach a promising orebody indicated at the toe of the glacier. The Porter-Idaho tram-line has been dismantled and reerected from the main Silverado portal to the head of the truck road to Stewart and will later be extended to the proposed millsite at tidewater.

★ Indian Mines (1946), Ltd., has received $32,000 on a firm commitment for $40,000, covering purchase of 400,000 treasury shares at 10¢ per share. Balance was payable by Nov. 2, 1946, and, if further options are exercised, an additional $80,000 will be received during 1947. Dr. J. T. Mandy, consulting geologist, has recommended a geological study, drifting, and diamond drilling, the last to be started on the third level to determine whether the ore developed on the first and second levels of the company's Portland Canal silver-lead property continues downward.

★ Initial payment of $300,000 has been made by Mining Corporation of Canada, Ltd., on the purchase of the Toric group of silver-lead claims at Alice Arm, on which work is being rushed to get into production before the end of 1947 on a 300-ton daily basis. The property was extensively developed 15 years ago by Britannia Mining & Smelting Co., Ltd., and contains ore reserves in excess of 400,000 tons with a high silver content.

★ Shareholders of Privateer Mine, Ltd., leading gold producer of the Zeballos district, have been advised of favorable development on the Fandora group of claims near Tofino, acquired on option last winter. N. E. McConnell, managing director, and the consulting engineer, A. M. Richmond, describe it as a reasonably assured mine. Tunneling and surface excavation have established a length of 1,600 ft. on the strike over a vertical range of 900 ft. On the 2,100-ft. level two ore lengths have been developed, one for 105 ft., averaging 0.46 oz. gold per ton over 3.0 ft., and the second for 100 ft., averaging 1.13 oz. over 1.26 ft. with the face in ore. On the 1,900-ft. level, two orebodies have been opened, the first for 450 ft. aver-

aging 1 oz. over 1.77 ft., and the second with a present unlimited length of 160 ft. yielding 2.85 oz. over an average width of 1.07 ft. In the new level being driven at 1,700 ft., an ore length of 40 ft. averaging 2.99 oz. over 2.15 ft. has been opened to date. The company's engineers estimate reserves developed up to the present at 55,100 tons averaging 0.4 oz. gold over a mining width of 5 ft.

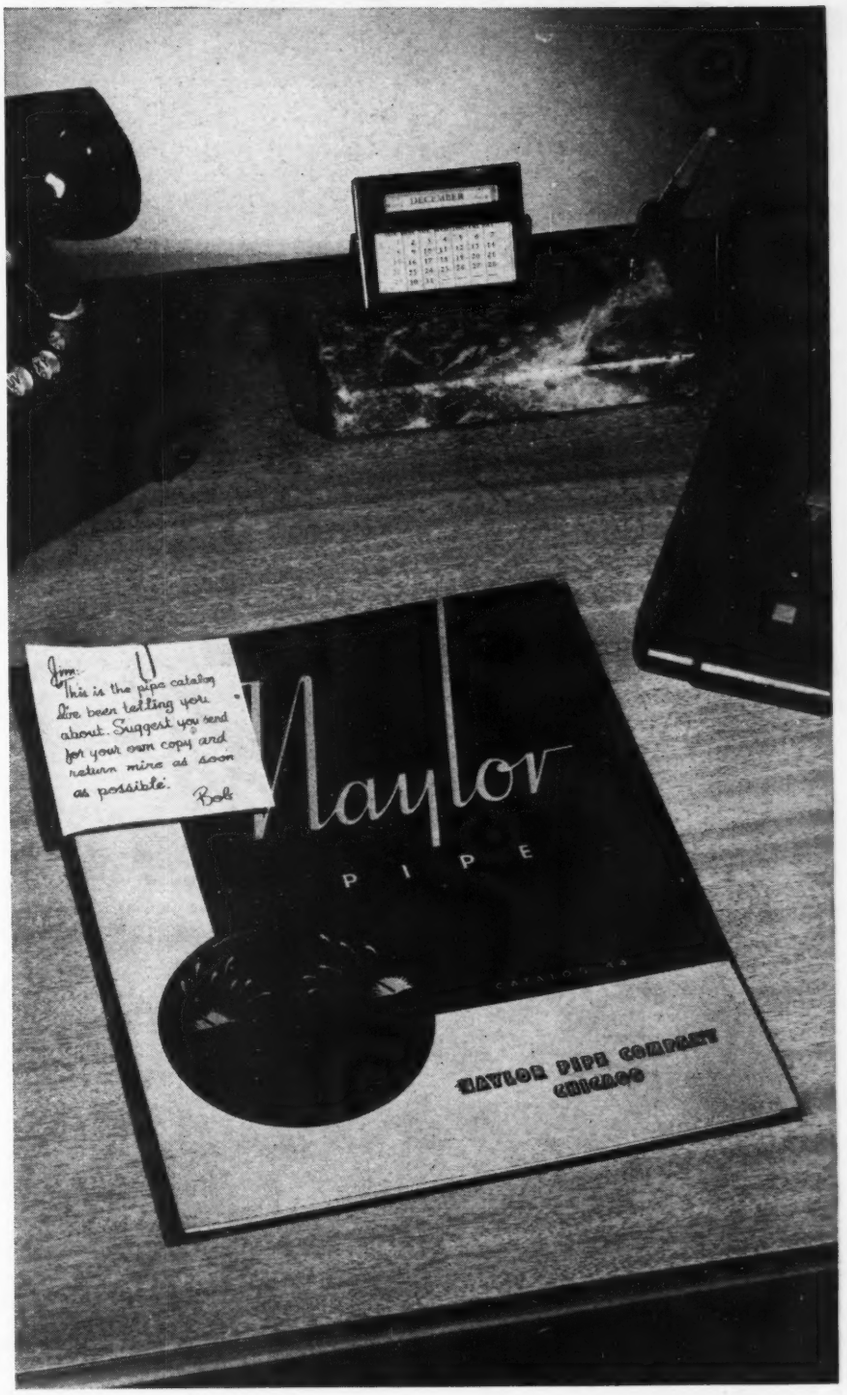
★Olier Besner, president of Twin "J" Mines, Ltd., reports the discovery in the company's Mount Sicker mine, Vancouver island, of 9.5 ft. width in the South orebody averaging $26 per ton in metals at present prices. Values across 60 in. show gold 0.12 oz., silver 1.9 oz., copper 1.6 percent, and zinc 8.4 percent. A second section yielded 0.3 oz. gold, 3.0 oz. silver, 4.2 percent copper, and 2.9 percent zinc over 18 in. The company is financed for extensive development.

★Discovery of high-grade gold-copper ore on its St. Joseph claims on Lasqueti island, Nanaimo mining division, is reported by Lasco Gold Mines, Ltd. The ore, cut at 180 ft., is good enough to stockpile with that taken from development faces for treatment later. The drift will be advanced to approximately 2,000 ft., after which a shaft will be sunk to 250 ft. to open two levels.

★During the fiscal year ended May 31, 1946, the capital structure of Congress Gold Mines, Ltd., was increased from 2,000,000 to 4,000,000 shares of $1 par value. Sale of 1,250,000 of these shares netted the treasury $80,500 and the remaining stock was then granted on option to Sheep Creek Gold Mines, Ltd., at 11c. per share. To date Sheep Creek has taken up 500,000 shares, and, when it completes its option, will have the right to purchase an additional 1,000,000 shares to be provided by again increasing the capital, this time to 5,000,000 shares. Shaft sinking has been temporarily halted at the 275-ft. level to permit lateral development.

★North American Goldfields, Ltd., has stopped work on the Ashby-Speers leases on Spanish Creek, Quesnel mining division, and moved all equipment, including dragline dredge, washing plant, and portable camp, to its French Flats leases further downstream on the Quesnel River. At French Flats, Glenville A. Collins, managing director, estimates the reserves to average 38c. per cubic yard and to be sufficient to maintain capacity operation for two years. Everything will be done to expedite an early start next spring.

★Diamond drilling is under way at the Westport group, formerly part of the holdings of the Cariboo Gold Quartz Mining Co., Ltd., but now held by Williams Creek Gold Quartz Mining Co., which is owned partly by the Cariboo Quartz company, Quebec Gold Mining Corporation, and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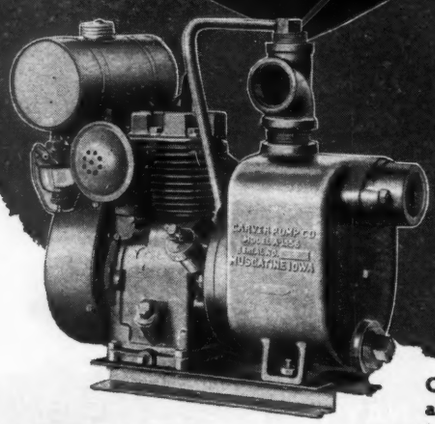

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Canada *(continued)*

Noranda Mines. P. N. Pitcher, formerly mine manager of the Cariboo Gold Quartz, is in charge of present work, which includes two drills on two shifts.

★Copper Island Mining Co., reports encouraging results from diamond-drilling of its Babine Lake property in the Omineca division. The first hole drilled shows consistent copper mineralization for 900 ft., assays for the first 160 ft. averaging 1.25 percent copper. B. I. Nesbitt, consulting geologist, describes the deposit as a stockwork of intersecting quartz veinlets containing chalcopyrite and bornite in fractures in a shattered diorite stock. It is claimed that potential tonnage to a depth of 500 ft. is large and the ore can be mined by low-cost open-pit methods.

★Surface stripping is under way at the Fry group of gold-silver claims in the Greenwood mining division. Pilot Gold Mines, Ltd., Bridge River operator, which acquired the option last spring, has made the last of its 1946 payments and is doing surface stripping and trenching, underground work being projected for 1947. The company plans to sell the equipment at its gold property on Little Gun Lake, Bridge River district.

★No dividend was paid to shareholders of Sheep Creek Gold Mines, Ltd., Nelson district, in October, marking the first time in the past decade when it was passed. At the Lucky Jim mine of the wholly owned subsidiary, Zincton Mines, Ltd., a silver-lead-zinc orebody has been developed at 1,300 ft. above the mill. A road has been built from the mine camp to the portal and connection made with the mill by tram line. A lead circuit has been added in the mill to treat the new ore. Previously Zincton has shipped only zinc concentrate.

★R. Crowe-Swords, president of Santiago Mines, Ltd., reports presence of cassiterite in zinc ores of the Bosun and Hartney mines in the Slocan division. Samples from the Bosun's seventh level average 0.23 percent tin, which would increase the value of crude ore by $2.29 per ton. Zinc ore is being stockpiled pending settlement of the strike of the International Union of Mine, Mill and Smelter Workers, after which it will be treated at the mill of Western Exploration in Silverton. Lead ore is shipped to Trail, the first carload, of 30 tons, averaging 55 percent lead and 188 oz. silver per ton.

YUKON

★August production of The Yukon Consolidated Gold Corporation, Ltd., was valued at $304,000. G. Goldthrop Hay, president, who inspected the company's various dredging operations last month, has since returned to England.

CHILE

Aid for small mine studied by Ministry — Restriction of mining studied for certain zones

★Amendment of Art. 17 of the Mining Code to make it necessary to get permission from the President of the Republic to do mining within zones defined by the Ministry of Defense, or within 3 km. of them, is being discussed in Congress.

★Crane men at Chuquicamata who have the task of unloading the ore from the vats struck for higher wages illegally recently. A raise was granted and they went back to work.

★A small iron blast furnace, using charcoal as fuel, has been started 35 miles west of Talca, which is south of Santiago. It will make 70 tons of pig iron per day to make bars for reinforcing concrete. High-grade iron ore and limestone flux can be obtained nearby. About $500,000 has been invested.

★Petitions for increased wages, insurance, family allowances, etc., made by Braden Copper employees, are following the course prescribed by law, though several small strikes have occurred in certain departments which have cut production. If agreement is not reached the question of a strike will be put to vote. (The men struck, after this letter was mailed from Santiago—Editor).

★Cia. Min. Punitaqui, the principal gold producer in Chile with its average output of 1,900 fine ounces per month, has its new cyanide section running satisfactorily. It is treating its own gold-copper pyrite concentrate running 10 percent copper and 3 to 4 oz. of gold.

★Metals Reserve Co. has recently closed another contract with the Anaconda and Braden companies to buy 50,000 tons of copper during the third quarter of this year at 15¾c. per pound, an increase of 3¾c. f.o.b. Chilean ports. Half of the excess in price above cost, or above 10c. per pound, will go to the government.

★Cia. Min. Chañaral-Taltal has recently closed its 50-ton cyanide plant owing to rising costs and decreasing output. It mines narrow, fairly high-grade veins in the Altamira district and has seen its output drop from 9 to 3⅛ tons of picked ore per man per month. It will continue to mine high-grade ore for export and cyaniding lower-grade ore for sale to the Caja de Credito Minero.

★Production from the small and medium-size mines, including the French-owned smelters of Chagres and Naltagua, which during the war reached about $19,000,000 per year, has fallen to less than half that amount due to the closing of a large number of small copper and gold mines, accord-

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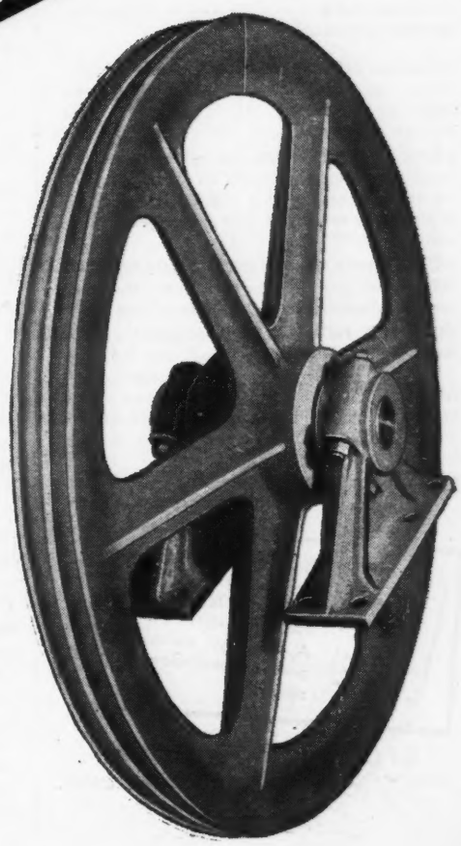

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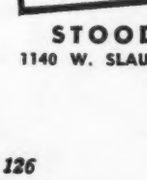

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Chile *(continued)*

ing to the Minister of Economy. The Minister is said to be studying a plan to help the small mining industry. It is difficult to see what plan would be of any benefit except to increase the value of the mining products, as by a bonus payment, such as Caja de Credito Minero is doing, since the increase in costs has been great since 1942.

★Two of the largest gold placers in Chile, namely Madre de Dios and Roble, in the southern province of Valdivia, will probably be compelled to close due to an injunction obtained by neighboring farmers who complain of damage to their land by tailings.

★Nitrate is again being shipped from Chile to France, having been stopped since the war began in 1939. Small sales of copper are also being made.

★UNRRA has bought in Chile about $10,000,000 worth of copper, nitrate, rice, and other products of which there is great scarcity in Europe.

★Production of nitrate for the year ended June 30 reached only 1,600,000 metric tons in round numbers, instead of the estimated 1,800,000 tons hoped for. The decrease was due to strikes.

AUSTRALIA

Zinc Corporation is exploring outside mineral fields — Tennant Creek field developing slowly

★In the three months ended June 11, Central Norseman Gold Corporation, 160 miles south of Kalagoorlie, treated 23,910 tons of ore running 6.2 dwt. gold per ton, for a recovery of 7,381 oz. of gold and 4,761 oz. of silver. Recovery was 95 percent, of the residues running 0.302 dwt. per ton. Average working costs were 36.9s. per ton. The lode is about 4,000 ft., long with a width varying from 5 ft. to 30 ft., and dipping east at 43 deg. The deepest working horizon approximates 2,000 ft. from surface. Development during the period was done on three levels, Nos. 14, 16, and 22. The two latter appear to have reached the northern end of the ore zone, and, though the lode continued in the No. 22 level, no values were recorded. Preparations are in hand at No. 22 level for diamond drilling, to test lower horizons.

Exploratory work on the adjoining Princess Royal lease, once a prominent producer, has been unsatisfactory, and the results obtained by diamond drilling have not been confirmed. It appears that the gold values then located are confined to a small shoot at No. 9 level. An interesting discovery has, however, been made in a hole diamond-drilled into footwall country, 216 in. of quartz assaying 24 dwt. gold per ton. In the main, or Mararoa lease, a bore from surface cut three significant reefs, but values thus obtained were low. The Mararoa lode is in schistose greenstone, with laminations parallel to the lode. The country rock is traversed by porphyry dikes. The gold is associated with pyrite, a little galena and bismuth.

NEW SOUTH WALES

★Zinc Corporation, Ltd., Broken Hill, has announced that in 1945, the company mined and treated 430,807 tons of ore assaying 15.2 percent lead, 3.8 oz. silver, and 11.4 percent zinc. Tonnage was slightly less than in 1944, owing to transfer of miners from stoping to development. Ore grade was slightly lower as most of the output was drawn from lower-grade sections. The year's output was equivalent to 60,346 tons of lead and 1,514,930 oz. of silver, with, in addition, 81,311 tons of zinc concentrate assaying 52.4 percent zinc. Mill recoveries were 96.9 percent lead and 87.8 percent zinc. Costs were: Mining, including development, 40s. 10.5d.; milling, 5s. 6.5d.; Total cost per ton (Sterling), 46s. 5d.

The war years were difficult, for the industry was not protected and, although the Commonwealth pressed for metal, the company had to release a large part of its men for national service. As a result, output declined in the later years of the war and development fell into arrears. During seven war years the mine produced 3,300,000 tons of ore, from which were recovered 480,000 tons of lead, 12,000,000 oz. of silver, and 627,500 tons of zinc concentrate. In the same period ore reserves were increased by 771,000 tons. The Zinc Corporation and New Broken Hill Consolidated mines adjoin, and are under the same management; combined employees on both properties now total 2,000 men. An interesting aspect of the year's activities is the incidence of taxation, and its unfairness to the industry. The company's profit before deduction of taxation was £Stg. 482,064, of which taxation required £354,686, or 74 percent, leaving to shareholders 26 percent of the profits. Expressed in another way, taxation amounted to 26s. 5d. sterling per shift worked by the mine employees. Ore reserves were estimated at: Lead lode, 4,200,000 tons; zinc lode, 279,000 tons; total reserves, 4,479,000 tons.

The reserves are limited to the zone above No. 16, or 2,280-ft., level. No. 19 level, 2,760-ft., is being opened up, and results indicate the orebody to have grade and width similar to those in the levels immediately above, so that it is expected that Nos. 17, 18, and 19 levels will produce an additional 6,000,000 tons of ore from the Lead lode alone.

The company is engaged in the exploration of outside mineral fields. In the Broken Hill district drilling is under way at the Pinnacles to the south of the Broken Hill line of lode,

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Australia *(Continued)*

where mining was carried on 300 ft. depth in the field's earlier years. To further the work of outside examinations, the company is preparing a geological and geophysical organization. In South Australia, the company has secured a large interest in a mineral field near Beltana, in the Flinders Ranges, now being investigated.

★Considerable interest in the social and welfare aspect of the community life at Broken Hill, fostered and financed by the mining companies, is apparent. To control mining dust, an area surrounding the town was inclosed some years ago so as to promote the growth of natural shrubs and herbage to arrest the sand drift. This work has been so successful that this regeneration area is to be increased to over 400 sq. mi. At the mines, much has been done in tree planting and beautification. The mining companies have incorporated in building a new hospital, which is to be enlarged at a cost of £A300,000, to which the companies will contribute largely. An Aero Club and Flying Doctor service are financed. Activities peculiar to the Zinc Corporation are an employees' retirement scheme and a mine cafeteria, opened originally for surface employees, but now extended underground, where meals are delivered to the various levels. A professorship at Adelaide University has been endowed, and the mining company has joined with the others in the establishing a chair of metallurgy at Melbourne University. The Zinc Corporation maintains a turf cricket oval and bowling green, and a swimming pool for employees, and a kindergarten is being provided for children of staff and employees. Assistance is being given by means of loans at low interest, and a building plant to assist employees in the erection of homes, and a boys' club, with a membership of 550 have been provided.

Educational staff tours for staff members are now being extended to employees.

VICTORIA

★Morning Star (G.M.A.) Mines is working a large auriferous occurrence at Wood's Point. The deposit is typical of many in a belt 60 miles long, and is somewhat unusual. The belt is traversed in a north-south direction by diorite dikes, which, at intervals, expand into bulges from 30 ft. to 300 ft. wide in width and 200 or 300 ft. to 1,200 ft. long. The bulges are traversed by faults, in which quartz reefs have been deposited, thickness varying from a few inches to several feet. Faults and reefs dip from side to side of the dikes, and in some cases, there has been marked displacement of the dikes, with extension of the reef on that particular fault into the containing Silurian slate. Reef dip varies from nearly horizontal to about 23

deg. The reefs are irregular in vertical sequence; in some mines the vertical interval roughly approximates 100 ft., in others it may be much greater, and in at least one mine there is a regular reversal of dip, the reefs, or "floors" turning on the dike walls to dip in the opposite directions.

The gold occurs more or less in shoots, is free-milling, and associated with some pyrite and a little bournonite. One mine in the belt has worked ore worth 3 to 4 oz. gold per ton over the past three years. In the last 12 months, the Morning Star mine treated 14,884 tons of ore, recovering 12,621 fine ounces of gold, including 492 oz. in concentrates, equivalent to 16.96 dwt. per ton. Ore reserves are estimated at 31,000 tons, running 12 dwt. per ton. The mine has been worked for about 80 years, and present workings are about the 2,000-ft. horizon. Oreshoots tend to occur on one or other wall of the dike and usually extend considerably across it. Costs for mining, milling, and development were 61.2s. per ton. Average assay value of the residues was 1.3 dwt. gold per ton, that of the heads 18.26 dwt. Recovery was 92.9 percent.

NORTHERN TERRITORY

★The Tennant Creek gold field, 600 miles south of Darwin, is the youngest auriferous area found in Australia, prospecting dating from 1933. Development has been slow, due in part to the unusual nature of the occurrence, to geological peculiarities, and to the excessive prices asked by vendors for their leases. Steady exploration by a few companies, with limited capital, has shown the increasing potential importance of the deposits, and that they may have considerable vertical extension, earlier opinion being that they would not exceed more than 200 ft. The gold occurs in pipe-like shoots, from 5 ft. in diameter to 26 ft. by 15 ft., with a few exceptional examples in which lengths up to 70 ft. have been proved. Many shoots end at a depth above 100 ft., but deeper exploration has shown recurrence at greater depth, and diamond drilling has located gold-bearing material at depths to 800 ft. The shoots occur in shear zones in close proximity to hematite lenses which are up to 700 ft. by 100 ft. in horizontal dimensions.

The hematite is not auriferous and does not appear to have had any influence on the deposition of the gold; the shoots are invariably located at the intersections of the main shear zones with subordinate cross shears. Lode matter is hematite and ferruginous schist, varying in proportion according as to whether the shear zone passes close to, or traverses part of a hematite lens. The gold is free and unassociated with sulphide minerals, but it is accompanied by some bismuth. Gold values may reach many ounces per ton, and the general average of the field is close to 1 oz. per ton.

The Government has erected three

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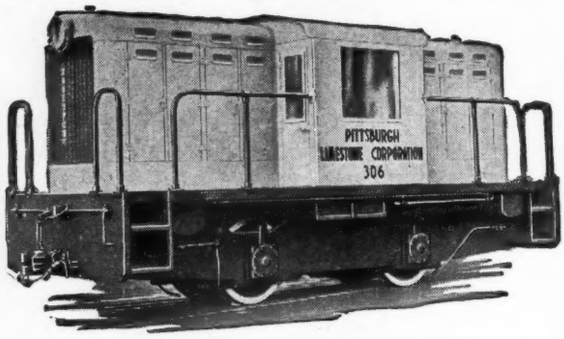

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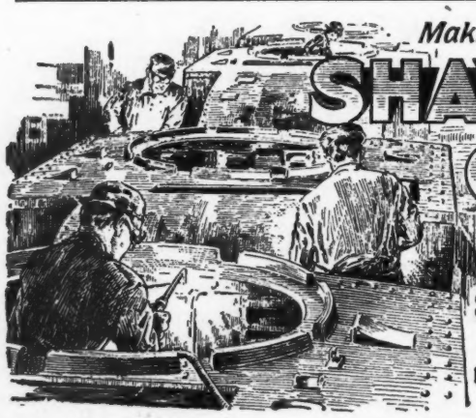

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Australia (*continued*)

customs mills in the field, equipped with 10 head of stamps, amalgamating equipment, and cyanide annexes for leaching sands, mixed with about 20 percent of slime. The ore offers no treatment difficulties, leaches readily, and a recovery of 90 percent is usual. The dimensions of the field are 50 by 30 miles. So far, some 90 mines have been opened up, most of them explored to a limited extent, but all of them have produced moderate grade to rich ore. The area is arid, water and timber are scarce, and the use of oil fuel is general.

AFRICA

Cost of living bonus increase offered mine workers on Rand

★The acceptance by the joint mining unions on the Rand of an increase of 1s. 6d. a day in the cost of living allowance to employees will be warmly welcomed by the Gold Producers' Committee. As is shown in the Transvaal Chamber's letter to the mining unions, the increase of 1s. 6d. a day in the cost of living allowance means on a shift basis 1s. 8.77d. per shift, with half rate for juniors, and the increase takes effect from May 1, 1946. The industry's offer appears to have had its source from investigations which had been started before receipt of the demand put forward in April for a 12½ percent increase in wages. This increase in the cost of living allowance will represent an additional charge on the industry of about £1,000,000 a year or 3.7d. per ton milled. The weight of these increases falls most heavily on the mines least able to bear them.

★Northern Rhodesia is undoubtedly relieved that a basis for settlement of the strike in the Copper Belt has been reached. In spite of the initial objection by the men, arbitration will be resorted to following the workers' acceptance of the general suggestion. Copper production stopped on July 18 after efforts to reach agreement between the companies and the artisans had failed. It is the only industry of any magnitude in the territory, and the effect of the strike on the commercial and railway systems must inevitably have been serious.

The men concerned were the mechanics' section of the Northern Rhodesia Mine Workers' Union, who demanded an increase of 10s. per day. The history of the dispute is illuminating. Only in April last the Union agreed to renew the existing wage agreement which provided 30s. per shift for surface artisans and 32s. for those underground. Only some six weeks later notice was given to terminate the agreement and of the 10s. a day increase. A joint conference of the

companies and the Union was held on July 12, when the companies stated they could not grant the 10s. demand, but that they had under review a scheme for the general readjustment of wages, and though that had not progressed far enough for decision, they were willing to concede an increase of 3s. a day to artisans as from Sept. 1. The Union delegates asked for a conciliation board, which was agreed to and at once met. The 3s. offer was repeated, but conciliation failed and a general strike was called. On Aug. 5, a joint meeting of the companies and the Union was held at which the Solicitor General, on behalf of the Northern Rhodesia Government, announced a suggestion of the Secretary of State for the Colonies that the dispute should be submitted to arbitration, work to be resumed promptly on that understanding. The companies announced at the meeting that they would accept the proposal, and, not only so, but were agreeable to grant the previously offered 3s. as from the day work was resumed. The Union Executive, however, on Aug. 12, intimated that it refused to accept the offer of arbitration "at present stage." In view of this, the companies announced that they would have no option but to discharge all daily paid workers except those required for essential services, and that the mines would close and be placed on a care and maintenance basis. The Union retaliated a few days later by calling out the essential men, thus jeopardizing the future of the mines. Suddenly there was a reversal of the attitude of the men, and at meetings at Nkana, Mufilira, Luanshya, and Nchanga it was decided to resume work on the terms proposed by the Government and already accepted by the companies. The British Secretary of State for the Colonies will now appoint an arbitrator.

★Production figures from some Southern Rhodesia gold mines for August, 1946, are Cam and Motor: Tons milled, 23,000; revenue, £43,039; working costs, £24,998; working profit, £18,041. Rezende: Tons milled, 20,300; revenue, £20,593; working costs, £19,587; working profit, £1,006. Sherwood Starr: Clean-up value, £4,276; working costs, £3,573; working profit, £703. The foregoing results are part of the final clean-up. Stores and machinery are being disposed of when opportunity occurs. Bushtick Mines: Tons milled, 12,100; total yield (fine ounces) 1,878; estimated working revenue, £16,020; working costs (including 2s. 6d. per ton for development redemption,) £14,507; estimated profit, £1,513.

★Anglo-American Corporation and the Blinkpoort Gold Syndicate jointly announce that Borehole No. 2 on the farm Rietpan intersected the Basal Reef at a depth of 4,787 ft., the assaying giving 124.8dwt. over a borehole width of 9 in. equivalent to 1,123 in.-dwt. Borehole No. 2 is about 1½ miles

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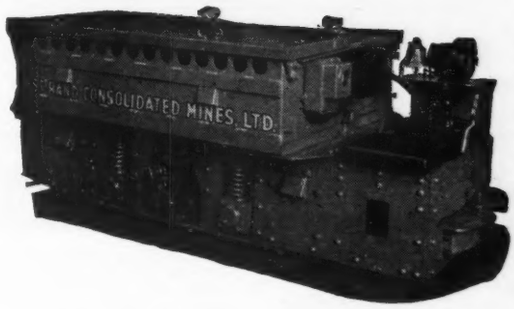

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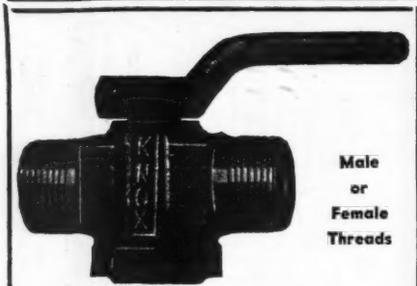
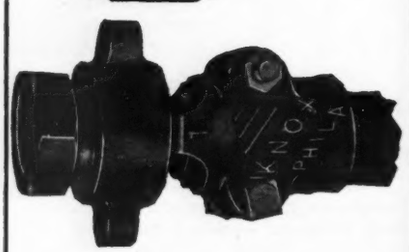


Male or Female Threads



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RUSSIA

Russians make mining equipment on U. S. patterns—Detachable bits do not equal U. S. product

★Mining equipment manufactured in Russia for use in Russian mines is beginning to appear, and a partial survey shows this equipment to be patterned largely after American models. Russian hoists are quite similar to Allis-Chalmers hoists that were used in rehabilitating the Donbas coal-mining region. Similarly, coal-cutting and loading machinery resembles American equipment. Under the new five-year plan, great emphasis is to be placed on increased use of mechanical equipment underground, mucking machines, scrapers, and conveyors principally. At present, 82 percent of all underground mining in Russia is done by hand, although this figure is somewhat misleading, in that it includes both coal and metal mining.

★Russian metal miners used both air and electric drills, and about 15 types of air drills are used and five electric. Detachable bits with sharpeners of the "Sullivan type" are said to be almost universally used. Thus far, American-made bits have been found superior to Russian-made bits, although composition of the alloys in each is similar.

Africa (*continued*)

northwest of the famous Geduld borehole, and is from 4 to 5 miles due south of Odendaalsrust. Borehole No. 1 on Rietpan, about 1½ miles northwest of No. 2 intersected Leader Reef at 4,872 ft., giving 1.6 dwt. over 22 in., and Basal Reef at 4,959 ft., giving 19.2 dwt. over 6.7 in.; in a deflection the Basal Reef gave 39.9 dwt. over 6.7 in. Adjoining Rietpan on the north is the Freddies farm Kalkkuil and the nearest Kalkkuil borehole of which the only result so far made available is KK7 about two miles northeast of Rietpan No. 2. In KK7 the Leader Reef was intersected at 5,461 ft., giving 20.2 dwt. over 7 in. and the Basal Reef at 5,536 ft., giving 37.8 dwt. over 6 in. In a deflection the Leader Reef, intersected at 5,462 ft., gave 17.2 dwt. over 7 in. and the Basal Reef, at 5,534 ft., gave 55.6 dwt. over 7 in.

★At the annual meeting of the Free State Development and Investment Corporation, Ltd., the chairman, said the drilling results in the area (in extent about five miles by four miles) surrounding the township of Odendaalsrust were such that the directors had given notice to the owners of the ground of their intention to exercise the options to purchase the mineral rights. In this area of 20 sq. mi. the prospects of payability shown by drilling were sound. Taking into consideration the narrow width of the Basal Reef it was considered that the area was sufficient for two large mines and preliminary steps had been taken to obtain the necessary mining lease.

M. M. S. A. Forum

(*Continued from page* 86

the factors of conservation and the protection of national self-sufficiency. Until we demonstrate our ability to provide adequate new mineral reserves, condemnation of known resources is against the public interest. He recommended the use of subsidies where condemnation was the alternative. In the matter of self-sufficiency, tariff is the simplest and most acceptable protective device, but the future seems likely to develop complexities which will make tariff protection of minerals inadequate. A means must be sought to afford increasing protection to domestic mining if necessary, without impeding the logical level of imports. Apart from cartels, the only other devices are import quotas and subsidies, but both were analyzed as having defects which give them no advantage over tariff under foreseeable conditions. However, the price of failing to seek a solution to all these problems is likely to be forced acceptance of amateurish policies, Just concluded. Cleveland E. Dodge, vice president of Phelps Dodge Corporation, noted that copper supply, with the war ended, is still less than demand. A situation unfair to low-cost

mines results when Government purchases imported copper at prices above the domestic ceiling and resells at a lower price. Artificial support of prices over an extended period would eventually saddle a great burden on the economy. Production agreements such as the publicly supervised but privately managed Interstate Oil Compact hold more promise of success than price regulation.

Domestic production of copper should be able to satisfy domestic consumption at the end of the present postwar period of abnormalcy, Dodge said. In case of a depression, domestic consumption would need tariff protection. Although stimulation of international trade through lower tariffs is talked about, results must be weighed against losses to producers now contributing to the national wealth.

Both the copper industry and the country as a whole will be benefited in the long run, Dodge asserted, if no subsidies are paid for conservation of mineral resources or for any other purpose. A copper price more in proportion to price levels in other industries would help greatly in tiding over the present period after premium prices are discontinued.

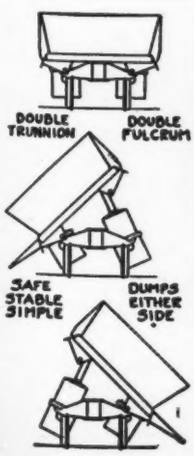
Howard I. Young, president of the American Zinc, Lead & Smelting Co., termed permanent subsidies dangerous to our economy because they would foster inefficiency. Artificial stimulation of output for the national emergency was justified, but we should now return as quickly as possible to a normal basis. The country will not go forward with industrial development at the same pace under price control as with free markets.

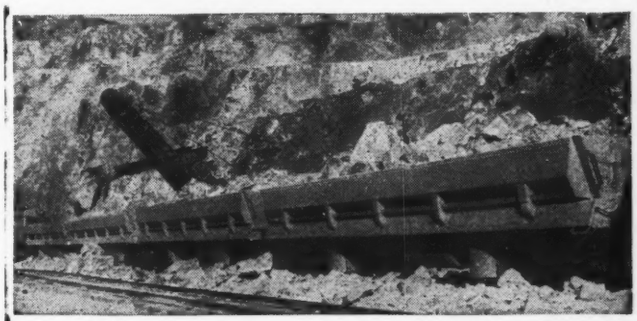
At today's world price, Young stated, there is sufficient zinc production to supply world needs. A price of 10c. to 10½c. per pound for Prime Western is adequate to encourage development of new ore reserves on a world basis. At the present world price level, the domestic industry can mine 600,000 tons of contained zinc metal annually at a reasonable profit, against annual consumption of 900,000 tons. At present the domestic price is $15 to $20 per ton below the world price, which means that the United States is subsidizing the consumer at the cost of the taxpayer instead of recognizing increased production costs and passing them on to the consumer.

Young suggested the following program: free zinc from controls, allowing prices to assume a level in line with world prices; remove Premium Price Plan subsidies with adequate time for orderly closing of low-grade mines; if and when foreign prices revert to sub-normal levels, restore adequate tariff protection; Government aid to marginal producers, if necessary, to bring out zinc needed for national defense over and above what can be supplied at the ruling market price.

Prompt return to a free, unsubsidized lead market was urged by Felix E. Wormser, secretary of the Lead Industries Association, who declared that extension of Government controls signifies continued inability to sell lead in the best market, inability to purchase needed foreign lead, inability to produce useful lead products greatly in demand, and determination by Government what lead-using items are to be produced and in what quantities.

Wormser expressed confidence that the lead industry does not subscribe to "producer compacts designed to stabilize production under Government surveillance," as advocated by Evan Just, and also contended that tariff protection should not be reduced, and that subsidies are undesirable because they destroy incentives. If subsidies are to be continued in peacetime, he said, the industry should drive for a uniform type of subsidy. Every pound of lead produced should receive the same subsidy per unit of weight, instead of being subsidized according to the individual profit position. Under the present system lead-mining companies which are receiving no premium are compelled to sell output at the ceiling price while the Government purchases foreign metal at 10.25c. and resells in the United States at 8.25c. This amounts to partial cartelization of the world lead economy by the Government.





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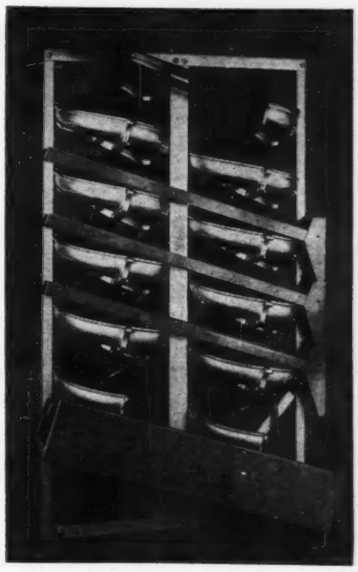

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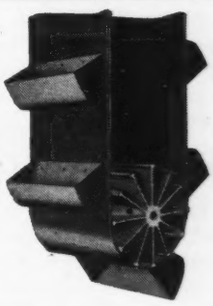

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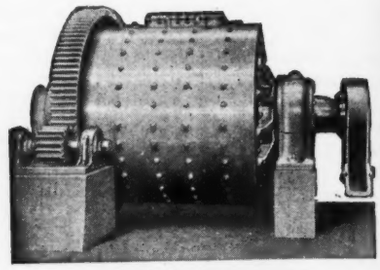

The very latest Rib-cone mill is the Champion series. To the right we show one of these. This modern all-steel welded mill is fitted with manganese liners and SKF pinion shaft bearings for low maintenance costs. Extra large diameter main gear permits the use of 1,800 RPM motors which are the lowest priced and most efficient. The Champion series Rib-cone mills are available in low pulp line, plain overflow, screening and convertible types with capacities ranging from 25 to 250 tons per 24 hours.

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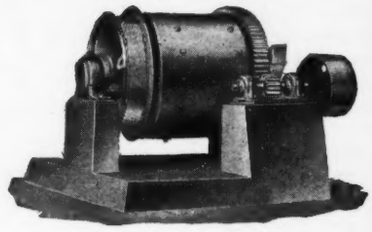
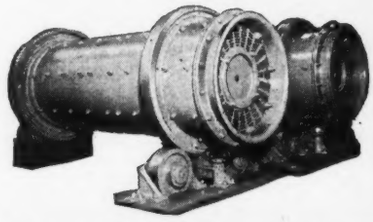


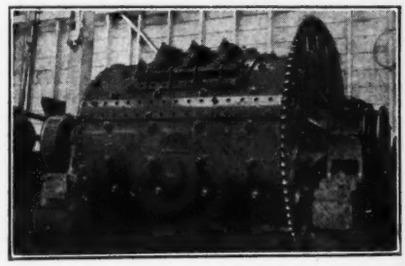
For grinding to a recommended maximum of 48 mesh and for those who want a mill that does not require a separate classifier, we build the Rib-cone screening mill shown at the right. The patented screening classifier, which is an integral part of these mills, delivers a clean product with the size controlled by the screen used. This type of mill is particularly suitable for amalgamating and concentrating classes of ores, and is the most economical to purchase and install. Rib-cone screening mills are all manganese fitted and are made in standard or sectionalized construction from 2 to 95 tons per 24 hours.

OPEN END GRATE DISCHARGE MILL



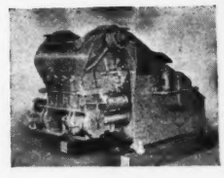
Here we show two open end grate discharge mills. This type of mill, with the discharge grate the full diameter of the mill, is particularly suitable for jobs that require a granular type product with a minimum of overgrinding. For the grinding of sands and concentrates in open circuit, these mills are unequalled. The feed end of the mill is supported on a large self-aligning hollow trunnion bearing. The discharge end is supported by a large steel tire resting on rollers fitted with sealed SKF bearings. The vertical thrust rollers on both sides of the tire are also sealed ball bearings. These mills are available in several sizes.

SECTIONALIZED MILL



Take advantage of our 40 years' experience and leadership in building sectionalized mining machinery. We can furnish a complete sectionalized plant or a sectionalized Rib-cone mill as shown at the right. The mill shown is made in sections for field rivetting. Every piece of sectionalized equipment is completely assembled in our shop before shipment. Then it is clearly marked and knocked down for shipping. This method of shop assembly avoids costly errors and permits reassembly with unskilled labor. We make sectionalized equipment in a wide range of types and sizes for "Anywhere a Mule Can Go".

KUE-KEN* CRUSHERS



If you are interested in increasing your present mill capacity easily and at not too great an investment, we offer the KUE-KEN crushers. The KUE-KEN Balanced crushers are available from 5 to 50 tons per hour capacity. The KUE-KEN Simplex crushers are available from 60 tons per hour and up. Both of these crushers operate on the exclusive principle of crushing "without rubbing" for less jaw plate wear, greater capacity and less power requirements. The increased percentage of "fines" produced by these crushers increases mill capacity considerably. In one installation a KUE-KEN that required less than half the horsepower of the previous crusher jumped the ball mill capacity from 7.28 tons per hour to 10.71 tons per hour, an increase of 47%. The finer feed delivered to the ball mill reduced the ball consumption from 1.1 kilos per ton to .9 kilos per ton. Catalogs 602 and 603 give details on these crushers.

***Pronounced Q-KEN**

STRAUB MFG. CO.

520 CHESTNUT STREET — OAKLAND 7, CALIFORNIA

Kue-Ken Balanced Crushers	Rib Cone Ball Mills	Overflow Classifiers
Kue-Ken Simplex Crushers	Concentrating Tables	Feeders
Kue-Ken Gyracone Crushers	Overhead Eccentric Crushers	Screenwheel Classifiers